SCIENCE

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THE ARTIFICIAL RIPENING OF BITTER FRUITS[1]

This subject has been chosen not only because of a certain intrinsic interest which I trust will presently be admitted, but because also it serves to illustrate the important contention that the problems of pure and applied science go back for their solution to the same fundamental principles. It is true that empiricism has solved, in a measure, many practical problems, and that, indeed, science has grown out of empiricism. But science in her turn leads more rapidly and surely to the goal which is sought, for the simple reason that she explains why things happen as they do. For a single and almost overworked example, the ancients knew that peas and clovers enriched the soil, and this knowledge led to the practise of rotation in the planting of crops. But it is very recent knowledge that this behavior is due to the peculiar relations of certain bacteria to a limited group of the higher plants known collectively as the legumes, by which the free nitrogen of the air is made available to the latter. The economic salvation of immense areas, yet to be accomplished, may now be compassed with this knowledge—a very practical outcome. On the other hand, the understanding of the nitrogen relations of plants has stimulated the chemist to discover a method, and if possible an economical method, of fixing atmospheric nitrogen, so that this vast storehouse of material may be rendered more available, the solution of which problem could not by any chance have been attained except by

[1] The university lecture, October 8, 1912.

the application of highly theoretical knowledge.

A further, but less widely appreciated, example of the same thing is afforded by the present subject, namely, the control of the certain ripening processes in bitter, or rather astringent fruits. We shall see, as the details are unfolded, that here too empiricism has preceded science, but that science is at the moment endeavoring to explain experience, with the result that, while problems of very great practical importance are being solved, new facts of still greater theoretical weight are being discovered.

Astringency in fruits and other plant parts is due to the presence of tannin in some form, very frequently tannic acid. It will suffice here to speak of it simply as tannin. Certain kinds of bark and other parts of many plants contain this substance in such quantities that they are used for the tanning of hides and for the extraction of tannin for other purposes, some of which are medicinal. The usefulness of tannin in the arts depends on its peculiar property of being able to enter into combination with many other substances, such as proteins, gelatins, mucilages and the like, to form complexes (or compounds in a loose sense) which have in common the peculiar property of resisting agents of decay. This fact is perfectly well known and tannin has been made use of since time immemorial as a preservative of material exposed to conditions favorable to decay, such as sails, fishing tackle and the like.

But if one wishes to have a more vivid impression of this peculiarity of tannin seen in its ready combination with colloidal materials, one needs but to take into the mouth a few drops of a solution of tannin, or to bite into an astringent fruit, such as the persimmon, or an unripe banana. The tannin in these will quickly attack and combine with the skin of the mouth, and produce the drawing or puckering effect familiar to all. The same experience is had on drinking tea which has been too long standing. What happens in the mouth may be accurately and simply described as a rapid manufacture of a thin coating of leather over the mucous membranes.

Another peculiarity of these tannin complexes, such as leather and the like which it is necessary to mention briefly, is this, namely, that one may easily extract with water a certain amount of the tannin without any obvious change in the physical character of the complex. If we soak leather in water, we can show that some of the tannin has come out. We may do this repeatedly, and always get some but again always, a decreasing amount of tannin. An analogous example is afforded by certain dyes which stain the cotton fiber but which may be extracted in repeatedly diminishing quantities by water. Such complexes are said to arise by adsorption; they are not, at any rate, chemical compounds in the ordinary sense. In this connection our attention should be drawn to another fact of prime importance in what follows. It is that dyes are held more tenaciously by coagulable substances, such as the white of egg, when they are in a state of coagulation than when not, so that, given a certain amount of dye and a certain amount of the albumin (or whatever other substance may be used), a less amount of the dye can be extracted by water if the albumin has been coagulated by heat—as happens when an egg is cooked—than otherwise. I have shown that tannin in its relation with a coagulable substance in the persimmon, analogous to the white of egg, acts in the same way. The significance of this in relation to non-astringency of fruits will be indicated as we proceed.

The term colloid has already been used.

Inasmuch as the living body, whether of the plant or of the animal, is made up, aside from the water content, very largely of colloids, I must venture, at the risk of appearing to dwell overmuch upon very elementary matters, to draw attention to certain of their characteristics. In negative fashion, a colloid may be described as a substance which does not crystallize, and this feature serves to contrast it with other substances, such as salts, sugars, etc., which, upon going out of solution, assume geometrical forms. It is more difficult to define colloid in positive terms, but fortunately we are all of us familiar enough with them so that we do not need a formal description. Glue, gelatin, mucilage are examples. Tannin, which claims our especial notice at this time, is also a colloid. When colloids are dissolved in water, they break up into particles which are far too small to be seen with the naked eye, but which are very much larger than the particles in a solution of a crystalloid. These may be identical with the molecules, or still smaller, when they represent the ions, or grosser components of the molecule small beyond even the strongest powers of the microscope. Colloids, however, in many cases, may in their dissolved condition be seen by means of the ultramicroscope, when they appear as minute brilliantly illuminated particles (suspensoids). One may understand this by recalling that a very small mirror at a great distance can be seen when it is caused to reflect the sunlight into the eye of the observer. The ultramicroscope therefore enables us in many instances to see what goes on in solutions of colloids. For example, it makes it possible to watch the process of coagulation in those colloids in which coagulation is possible. Thus, if we examine a weak casein solution—we can make such by thinning skimmed milk with water—we see a very pandemonium of dancing illumined particles. These remain in constant motion, flying hither and yon at a rate of speed too great to follow with the eye. If now we add a minute amount of an acid, the particles may be observed to hit one another and to remain in contact, so forming a continuous mass or apparently continuous, since we know that water is held within the coagulum. Quite similar appearances may be had by adding a solution of tannin to one of gelatin.

If, however, before adding acid to the casein solution, we add a little mucilage, the coagulation may be prevented. This illustrates the principle of colloidal protection—in this instance the mucilage protects the casein from the action of the acid. I have shown that a similar relation exists between tannin and mucilage as against alkaloids. Tannin immediately precipitates an alkaloid, such as antipyrin, in solution in water. When, however, a mucilage has previously been added, the precipitation is prevented. If, therefore, on adding an alkaloid to a solution of tannin we get no precipitate, we must argue that there is a third substance present which protects the tannin. Such a condition will be shown to occur in the fruits with which we concern ourselves to-day.

We now turn to examine typical examples of fruits which, before entering the condition regarded as edible, are highly astringent, but which, when "ripe," appear to be entirely devoid of the astringent principle, tannin. I use this wording advisedly, since the fact is that such fruits contain quite as much tannin when nonastringent as before. What has become of the tannin I propose to show you. The examples in question are the date of Arabia and Africa, the staple food product of the Arab, and the persimmons of eastern Asia and of North America.

The fruit of the date palm is hard, green and highly astringent, the approximately oval shape and the size varying in the different varieties, of which there are many. When ripe they may be dry or very soft and syrupy, again according to the variety. The soft dates when ripe can not be transported unless they are dried and packed, and it is in this condition that we are familiar with this fruit. In order to market the soft varieties so that they may be consumed in the fresh condition, the Arabs have practised for many centuries the art of artificial ripening. This consists in exposing the bunches of unripe fruit to the vapors of vinegar, of which the active agent appears to be the acetic acid, judging from the experiments of Vinson, of the Arizona Agricultural Experiment Station. Among other changes which take place during the artificially induced ripening period, the most obvious is the rapid disappearance of astringency, so that the quite inedible fruit of to-day is ready to the palate on the morrow or at latest the following day. Vinson further found that there is a great variety of chemicals which can produce the same result; so various in kind indeed are the chemicals that the changes in the fruit can not be explained as ordinary chemical reactions. Supranormal temperatures up to 70 degrees Fahr. may also be used, but higher temperatures kill the fruit, after which it is impossible to render them non-astringent. There is, however, a distinction to be drawn at this point between the effects of certain ripening agents and others. Thus, when some chemical substances, such as acetic acid, nitrous ether, etc., are used, the tannin changes from being colorless to red, indicating that it has been oxidized. Oxidized tannin is tasteless, so that in such case the non-astringency is readily explained. If heat or alcohol be used, the tannin remains colorless, and as such is astringent, so that, if it can not be detected by the tongue, this is the result of some other condition than oxidation. Indeed the evidence is well nigh conclusive that during the ripening of the date the tannin remains unchanged chemically, but that its collophysical relations have been changed. That it is still present may at once be demonstrated by the use of suitable chemical reagents—their suitability depending on whether the reaction produces a color change or not. Thus the salts of iron and other metals produce the corresponding color changes; alkaloids produce no change. It has been pointed out before, however, that the reaction of alkaloids and tannin may be prevented by means of a protector and this leads us to the conclusion that non-astringency in the ripe date is due not to the destruction of the tannin or to any chemical change in it, but to the presence of an efficient protector. Further evidence for this will be given further on.

The persimmon occurs wild as a single recognized species in North America, and the fruit is known in the south as the "'possum persimmon" for the reason that the opossum fattens on it in the autumn. In China and Japan there are numerous cultural varieties, most of which resemble a ripe tomato in size, shape and color. Certain kinds lose their astringency before they soften, and can be eaten as we eat apples, biting into a firm flesh. Others become edible only after becoming quite soft and watery, so that a spoon becomes an appropriate implement for managing them. Still another kind, described as an "astringent variety" is used as the source of a fluid, called "*kaki-no-shibu*," obtained by mashing up the fruits in water and allowing the mash to ferment. The product is used for waterproofing fishing lines and nets, and for coating wrapping paper,

paper umbrellas and similar services[2]—examples of the preserving effect of tannin. The peculiar properties of kaki-no-shibu, however, as the Japanese chemist Ishikawa suspected years ago, is not due to the tannin content alone, but to the joint action, as I believe, of the tannin and another substance of mucilage-like character with which the tannin is combined much as it is with hide to make leather.

We are concerned here, however, with those edible sorts which do not become non-astringent without at the same time softening. These when quite ripe can only by courtesy be called edible—decayed would better describe their condition. They have lost a fine aroma and a delicate sweetness which, coupled with a crisp firmness, would, in the absence of tannin, make up the qualities of a delicious fruit, as those know who have eaten them after being ripened artificially either in Japan or at home. This is accomplished by the Japanese, as it has been for centuries doubtless, by packing the hard, unripe fruit in freshly emptied tubs, in which sakè, the national whisky of that people, has been kept. A fully packed tub is tightly closed and the contained air in them displaced[3] by blowing through a small hole, the air escaping by another. The openings are then plugged so that the package is made air-tight. In the course of a few days, the length of time depending upon the variety under process, the fruit becomes edible without losing its firmness. This hastening of one of several independent processes, spoken of collectively as ripening, resulting in non-astringency, has been regarded as due to the action of some constituent of the sakè, with which the wood of the cask is of course soaked. This may be either the alcohol or a slight amount of acetic acid. I have argued, from experimental data, that it is the alcohol which, by stimulating the fruit to respiration in excess of the normal, quickly causes a formation of carbonic acid gas in addition to that which is introduced by the breath. At any rate, there is little doubt that the carbonic acid gas is the active agent, since Gore, of the Bureau of Chemistry, U. S. Department of Agriculture, found that certain varieties of persimmons grown in the United States could be treated with carbon dioxide at normal pressure with results quite similar to those obtained by the Japanese with their ancient but empirical method. Gore's experiments were in part repeated by myself at the State Experiment Station of Alabama, with like outcome. It was found that the variety known as *Hyakume*[4] grown on the station grounds if exposed for about eight days to an atmosphere of pure carbon dioxide, loses its bitterness while still remaining firm and crisp, and retaining its aroma and sweetness. The fruit so treated was most excellent to the taste, as testified to by a number of persons whose skepticism regarding the edibility of a hard persimmon had been begotten of much experience, and whose testimony was therefore of the greater value.

At this point a question arose. If a pure atmosphere of carbon dioxide at ordinary pressure induces the already described result, why should not an increased dosage effect the same result more rapidly? To attain to the answer I exposed the same variety of fruit to twice the amount of the

[2] Bishop Heber Hamilton informs me that kaki-no-shibu is used also for painting exposed woodwork, but is efficient only for a year. When applied it is colorless, but turns red in a few days—evidently by oxidation of the tannin.

[3] According to some accounts, this is done when reclosing the package after it has been opened to test the fruit.

[4] There are two varieties of Hyakume recognized, one of which is astringent until softening intervenes, while the other loses its astringency while still firm.

gas by using a metal tank which would maintain the required pressure. Into this was forced the gas to an indicated pressure of 15 pounds, which means that two volumes of the gas were compressed into the enclosed space of the apparatus. Under these conditions the fruit became quite edible in less than 46 hours. That is, the time required to render the fruit non-astringent under normal atmospheric pressure was reduced to one fourth that time, or rather less, as it later appeared, by increasing the pressure twice. This was in the autumn of 1911, at the time when no further experiments were possible. During the early part of September, 1912, the experimentation with supranormal pressures was renewed. A special apparatus had already been devised, composed of a piece of four-inch gas pipe, suitably capped, and supplied with a pressure gauge and with outlets guarded by gas cocks. This device enabled me to try the effects of pressure reaching up to 90 pounds, or seven times the original dosage. It is interesting to note that this high pressure kills the fruit in a few hours, so that it becomes watery and unattractive. It is nevertheless non-astringent. The effect, however, of 45 and of 15 pounds pressure separately were determined with considerable accuracy, with the following result. The fruit exposed to 15 pounds pressure became non-astringent in about 36 hours; that subjected to 45 pounds in about 15 hours. We may say, therefore, that, as the pressure of the carbon dioxid increases, the period of time required for causing the apparent disappearance of the tannin is decreased, and that the pressure goes up much less rapidly than the period is decreased. To make assurance doubly sure, the fruits which were used in the experiment which I have just briefly summarized ranged in degree of maturity from being entirely green, of the green of grass, to orange-yellow, the next to final color stage of ripening, and it eventuated that fruits which are entirely green can be rendered non-astringent in scarcely less time than those much nearer maturity, thus leaving no doubt of the significance of the experiments. To state these results in everyday terms of practical economics, we can say that it is now possible to ship, say on September first, green or near-green persimmons of the variety mentioned from Alabama to Montreal, where they should arrive in good condition, hard and without bruise or other blemish, on September third. Being, however, quite inedible, and with a prospect of remaining so for a month, or even longer, if kept in cold storage, the fruit is placed in a very simple and cheap apparatus, and subjected to 45 pounds pressure of carbon dioxid. The gas of course costs very little, and can be easily obtained—it is used in every soda water fountain. The next morning, that of September fourth, the fruits may be marketed, and if the fruit dealers know human nature as well as they appear to, the fruit would be readily disposed of at a high price, if properly displayed and advertised. Recurring to the fruit of the date palm, the methods which have been elaborated in Arizona, when finally given finesse, will make it possible to utilize vast desert areas for the culture of the date palm, and so making an otherwise useless waste contribute to human welfare. Of the cultivated persimmon something the same may be said. In California the culture of this tree has fallen into desuetude, and in the southeast hundreds of acres of persimmons are practically of no profit, for the reason that a method of marketing edible fruit has been wanting until now. It remains only to perfect in detail for the several varieties of

the fruit, the methods used by Gore[5] and as here outlined, when this desideratum will be compassed.

Having justified the scientific method from the practical point of view, as I believe to have been done, may I finally ask your attention to the further question which you will be sure to ask, namely, why carbon dioxide should act as it does. Why should a fruit which would remain under normal conditions inedible for its bitterness during a month or more, become quite edible in a week with a single dose of a certain gas, in 36 hours if the dose is doubled and in 15 hours if quadrupled? Let me prepare your minds for the answer by reminding you of the very familiar fact that it takes a good deal longer to cook an egg to hardness if a temperature considerably below boiling point is used than if it is subjected to 212 degrees or over. With this in mind, our attention may be directed to a few points concerning the structure of the fruits of which we have been speaking.

The edible flesh or pulp is composed of a great number of minute cellulose sacs (cells) each containing its quantum of living material as an inner lining, and this in turn filled with sap which is water with varying amounts of substances, such as mucilage, sugars, and salts, in solution. In both the persimmon and in the date, these sacs are of two quite distinct kinds, those from which tannin is absent, and which are relatively small; and those in which tannin occurs admixed with other substances in the sap. The tannin sacs are quite large, and may be readily distinguished by the unaided eye. You may see them in the ordinary dried dates of commerce as a layer of clear brown particles just beneath the somewhat tough skin. The color, however, is due to the oxidation of the tannin—in the fresh condition they are colorless, and can be recognized only by special means, that is, by applying suitable reagents which cause color changes in the tannin.

If now we choose a persimmon which softens before it loses its astringency, it is possible to isolate from the pulp single tannin sacs, which may then be examined under the microscope. If uninjured—if the cellulose membrane is not ruptured—the watery contents will glisten with a satiny sheen. On adding water so that the tannin sac is surrounded by it, the sac absorbs water and bursts, and the contents ooze out. This simple fact of bursting in consequence of the absorption of water proves conclusively that there is something more than tannin present, as tannin in solution can not absorb water sufficiently to produce such an effect. Sugar or salts might, if in sufficient quantity; but we can prove in another way that the substance in question is of neither of these classes of material, for it is capable of coagulation, in much the fashion that, as every housewife knows, we may coagulate jelly by cooling it, or an egg by boiling it. In the case of our tannin sac material, we may use heat, or a variety of chemical substances. Of these I shall, for the present purpose, mention but one class, namely, the alkaloids, such as antipyrine, quinine, etc. If a solution of any of these be applied in the room of water, the jelly-like mass may swell somewhat at first, but soon becomes hard and rigid, giving off water and shrinking accordingly. At the same time, however, within the interior of the coagulated mass there appears a coarse white granulation, which is caused by the union of the alkaloid with tannin within the jelly. This relation of tannin to the jelly is brought out still more strikingly if we examine, in the same way, a tannin sac which has been taken from a fruit which has become nearly

[5] Bulls. 141, 155, Bur. Chem., U. S. Dept. Agri.

non-astringent. If we take a portion of the pulp into the mouth we do not at first notice the puckery effect. In a few moments, however, this develops and becomes more and more pronounced during several minutes. Under the microscope we can actually watch the process. On adding water to some suitably isolated tannin sacs, the contents swell more slowly than before, but ultimately burst out and form a bubble-like mass on the side of the sac. In a few moments a granular veil is seen developing just beyond the surface of the protrusion, gradually increasing in size and moving away further and further. It would take us too far afield to explain why this peculiar behavior, so it must suffice to say that it is due to escaping tannin, which leaves the mass out of which it has escaped unaffected in shape and size. The matter is quite analogous to the washing out of color from cloth: the color goes, the cloth remains. Repeating our experiment with antipyrine, we now find that, while coagulation takes place, the amount of shrinkage is less than before, and the action of the reagent on the tannin within the mass is less apparent for the reason that the granulations are smaller.

If finally we treat a tannin sac from a quite non-astringent fruit in the same way we shall find that it will swell but little or none at all in water, that the alkaloid causes little shrinkage if any, and that the tannin reaction does not take place at all. That the tannin is still there is, however, apparent if we use other reagents, all of which nevertheless act much more slowly than they are known to do when unripe material is tested by them. The conclusion therefore to which I arrive is that the reason we do not taste the tannin in the completely ripened fruit is not because it is not there, but because the jelly-like material which occurs in the tannin sacs along with the tannin itself becomes coagulated during the ripening process, so that the tannin may not escape from it except at a very slow rate—too slowly far to be detected even by the delicate membranes of the mouth. To recall what was said earlier in the hour, the tannin is protected by the jelly, so that the alkaloid can not act on it —and this the more efficiently as the coagulation is the more complete. Tannin itself, on the other hand, is not a coagulable material. Although a colloid, it does not have the physical properties of a jelly or mucilage. In a word, we have in the tannin masses of the ripe fruit a sort of vegetable leather, which, like ordinary leather, gives up its tannin only very slowly, as shown by long exposure to water. I have tannin sacs of the persimmon which have been lying in water for over two years, but, aside from the loss of tannin, they remain quite unchanged, and will doubtless do so for years to come.

But what of the relation of all this to the carbon dioxid? We can form some notion of the matter if we step aside to enquire somewhat into the behavior of this gas. The more ordinary name, carbonic acid gas, indicates that it is an acid, and it is therefore of a class of substances which may exert a coagulating (or flocculating) influence upon various colloids. For a single example, carbon dioxide has been found recently to cause the coagulation of the milk or latex of india-rubber trees. In coagulated latex, the india-rubber occurs as minute droplets which remain individual and separate until some coagulating agent has its way, when they run together to form a continuous mass of india-rubber. This is only one example of the effect of carbon dioxid upon substances in the colloidal state, and by it we are led to suspect that its rôle in the artificial ripening of dates and persimmons is referable to its

coagulating power, a suspicion which is strengthened by the fact that the more there is available, as when it is supplied under pressure, the quicker is the effect. Some may look askance at so simple an explanation when so complicated a phenomenon is involved, and they are quite justified in doing so. This explanation is advanced not as final, but as a theory well worthy further examination by the experimental method, the method by which only can science be advanced, my purpose here being to discover a problem in science as it confronts the investigator rather than to lead you on the smooth, well-worn but less picturesque and romantic road in the domain of the already known. Let me, therefore, not tax your patience too far, enough, however, to allow me to reaffirm that the problems of science are not of mere academic interest; and that sooner or later they relate themselves to human life. The problem which has been outlined illustrates this principle, and it is one which I venture to assert is well worth the severe application of the investigator, entrenching as it does on that field of the physiology of the obscure processes of respiration, digestion, enzymatic action, the relations of crystalloids and colloids and the like—in short on that field where the physiology of living things, whether of animals or plants, overlaps the as yet undeveloped knowledge of collochemistry, a field surrounded by a wide horizon of the unknown, to pass which even with a stumbling tread requires a sure faith in the strength of the staff of scientific method.

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UNIVERSITY REGISTRATION STATISTICS

THE registration returns for November 1, 1912, of twenty-nine of the leading universities of the country will be found tabulated on the following page. Specific attention should be called to the fact that these universities are neither the twenty-nine largest universities of the country in point of attendance nor necessarily the twenty-nine leading universities, nor is there any desire on the part of the compiler to insist upon a quantitative standard as the only proper basis for comparison of our institutions of higher learning. Five institutions exhibit a decrease in the total enrollment (including the summer session), namely, *Cornell, Illinois, Iowa, Johns Hopkins* and *Pennsylvania,* while four institutions showed a loss in the total enrollment last year, and three in 1910 and four in 1909. The largest gains in terms of student units, including the summer attendance, but making due allowance by deduction for the summer session students who returned for instruction in the fall, were registered by *Columbia* (1,069), *California* (733), *Minnesota* (515), *New York University* (488), *Texas* (475), *Nebraska* (391) and *Harvard* (303). Last year there were four institutions that showed a gain of over three hundred students, namely, *California, Columbia, Cornell* and *Ohio State,* whereas in 1911 and in 1910 there were seven institutions that registered such an increase. Omitting the summer session attendance, the largest gains have been made by *Indiana* (990), *Chicago* (700), *California* (690), *Columbia* (484), *New York University* (375), *Nebraska* (337), *Texas* (318), *Cornell* (284), *Northwestern* (232) and *Syracuse* (209). It will thus be seen that this year ten institutions exhibited an increase of over two hundred students in the fall attendance, as against four in 1911, seven in 1910 and eleven in 1909. It will be observed that of these institutions four are in the east, five in the west and one is in the south.

According to the figures for 1912, the

Faculties	California	Chicago	Columbia	Cornell	Harvard	Illinois	Indiana	Iowa	Johns Hopkins	Kansas	Michigan	Minnesota
College, Men	914	879	819	} 1051	2306	454	1415	529	197	642	1550	633
College, Women	1425	720	590		483	348	925	494	...	540	732	908
Agriculture	429	...	...	1185	...	732	...	...	...	...	...	396
Architecture	116	...	129	133	†	341	...	...	...	...	†	†
Art	...	...	...	...	...	†	85	†	...	24	†	†
Commerce	297	...	...	...	107	206	...	†	...	...	†	...
Dentistry	89	...	...	...	192	...	...	176	...	...	252	239
Divinity	...	132	...	...	48	...	...	...	...	...	...	...
Forestry	†	...	...	...	†	†	...	...	...	...	†	†
Graduate School (non-professional)	382	490	1399	296	532	256	151	131	207	84	206	63
Journalism	...	...	72	...	...	†	70	...	...	...	†	...
Law	159	177	457	294	740	122	105	218	...	184	654	237
Medicine	108	127	336	120	288	...	142	113	351	79	298	180
Music	†	...	20	...	...	79	118	...	...	118	†	†
Pedagogy	†	266	1606	...	...	†	540	†	...	208	†	82
Pharmacy	87	...	420	...	...	176	...	...	...	72	92	77
Scientific Schools*	735	...	634	1419	132	965	...	168	...	380	1284	591
Veterinary Medicine	†	...	...	120	...	...	...	...	...	...	...	...
Other courses	...	740	...	...	...	269	...	...	17	...	...	12
Deduct double registration	*156*	*165*	*334*	*13*	...	...	...	*63*	...	*219*	*145*	...
Total, November 1, 1912	4741	3366	6153	4605	4828	3948	2340	1766	772	2112	4923	3418
Summer Session, 1912	2275	3531	3602	1307	1046	640	1197	324	201	469	1324	494
Deduct double registration	*403*	*546*	*748*	*500*	*145*	*273*	*280*	*146*	*29*	*178*	*627*	*319*
Grand Total Nov. 1, 1912	**6457**	**6351**	**9007**	**5412**	**5729**	**4315**	**2234**	**1944**	**1087**	**2403**	**5620**	**5063**
Grand Total Nov. 1, 1911	5724	6062	7938	5609	5426	4929	2154	1967	1238	2265	5452	4548
Grand Total Nov. 1, 1910	4552	5883	5883	5169	5329	4659	2102	1957	890	2246	5339	4972
Grand Total Nov. 1, 1909	3968	5487	5487	5028	5558	4502	2221	2246	792	2144	5258	4351
Grand Total Nov. 1, 1908	3644	5114	5114	4700	5342	4400	2113	2356	707	2086	5188	4607
Grand Total Nov. 1, 1903	3477	4146	4146	3438	6013	3239	1086	1260	694	1319	3926	3550
Extension and similar courses	894†	3031	2959	...	..21	1000	114	207	114	367	...	1326
Officers	486	337	867	825	771	577	93	226	206	178	472	442

Faculties	Missouri	New York Univ.	Northwestern	Ohio State	Pennsylvania	Pittsburgh	Princeton	Stanford	Syracuse	Texas	Tulane	Virginia	Washington Univ.	Western Reserve	Wisconsin	Yale
College, Men	774	413	452	423	384	} 400	1409	545	} 1313	773	152	368	162	456	749	1326
College, Women	480	182	563	380	...		...	442		634	249	...	217	354	727	...
Agriculture	454	...	...	720	...	...	...	...	37	41	...	...	...	...	802	...
Architecture	...	...	...	41	215	...	...	...	55	55	15	...	44	...	...	} 42
Art	...	...	...	...	...	...	...	...	175	...	68	...	...	...	...	
Commerce	...	1598	450	...	636	...	...	...	...	...	...	...	...	...	317	...
Dentistry	...	...	478	...	508	176	...	...	...	...	52	...	101	127	...	...
Divinity	...	...	222	...	...	...	...	...	...	...	...	...	...	...	...	100
Forestry	...	...	...	74	...	...	...	...	177	...	...	...	...	...	...	40
Graduate School (non-professional)	112	315	80	107	403	40	148	94	75	55	17	40	53	14	268	429
Journalism	55	†	...	...	...	...	...	...	...	...	...	...	...	...	95	...
Law	121	693	368	194	385	143	...	136	240	318	87	226	76	130	160	132
Medicine	56	408	258	...	313	136	...	46	86	150	349	90	68	168	65	45
Music	...	...	452	...	30	...	...	...	855	...	91	...	...	...	60	92
Pedagogy	181	355	...	129	...	478	...	...	20	398	97	...	...	...	54	...
Pharmacy	...	...	193	85	...	195	...	...	...	61	12	...	...	111	15	...
Scientific Schools*	344	190	57	726	713	235	161	398	305	289	132	99	159	...	728	1139
Veterinary Medicine	...	16	...	155	115	...	...	...	...	...	...	...	...	...	...	...
Other courses	...	...	178	252	808	102	...	...	151	32	10	...	78	50	5	...
Deduct double registration	*189*	*107*	*132*	*12*	*220*	*72*	*150*	...	*97*	*553*	*93*	*24*	...	*32*	*88*	*80*
Total, November 1, 1912	2388	4063	3619	3274	4290	1833	1568	1661	3392	2253	1238	799	958	1378	3957	3265
Summer Session, 1912	691	645	78	600	751	...	...	50	257	927	1116	‡	...	...	1741	...
Deduct double registration	*208*	*165*	*65*	*266*	*198*	...	...	*41*	*120*	*164*	*105*	...	...	...	*557*	...
Grand Total Nov. 1, 1912	**2871**	**4543**	**3632**	**3608**	**4843**	**1833**	**1568**	**1670**	**3529**	**3016**	**2249**	**799**	**958**	**1378**	**5141**	**3265**
Grand Total Nov. 1, 1911	2780	4055	3438	3567	5220		1543	1648	3307	2539	2040	781	859	1331	5015	3224
Grand Total Nov. 1, 1910	2678	3947	3543	3181	5187		1451	1648	3248	2597	1985	688	796	1274	4745	3287
Grand Total Nov. 1, 1909	2589	3843	3197	3012	4857		1398	1620	3248		1882	767	811	1083	4245	3276
Grand Total Nov. 1, 1908	2558	3951	3113	2700	4555		1314	1541	3204		1171	757	806	1016	3876	3466
Grand Total Nov. 1, 1903	1540	2177	2740	1688	2644		1434	1370	2207		1037	613	761	765	3221	2990
Extension and similar courses	305	700	...	273	...	451	...	...	...	330	152	...	207	Inc.	10,644	...
Officers	277	381	437	274	549	271	223	278	265	226	313	100	184	212	595	431

* Includes schools of mines, engineering, chemistry, and related subjects.

† Included elsewhere.

‡ 1285 students in attendance on summer courses (see note in body of article).

twenty-nine institutions, inclusive of the summer session, rank as follows: *Columbia* (9,007), *California* (6,457), *Chicago* (6,351), *Harvard* (5,729), *Michigan* (5,620), *Cornell* (5,412), *Wisconsin* (5,141), *Minnesota* (5,063), *Pennsylvania* (4,843), *New York University* (4,543), *Illinois* (4,315), *Northwestern* (3,632), *Ohio State* (3,608), *Syracuse* (3,529), *Yale* (3,265), *Texas* (3,016), *Missouri* (2,871), *Nebraska* (2,811), *Kansas* (2,403), *Tulane* (2,249), *Indiana* (2,234), *Iowa* (1,944), *Pittsburgh* (1,833), *Stanford* (1,670), *Princeton* (1,568), *Western Reserve* (1,378), *Johns Hopkins* (1,087), *Washington University* (958), *Virginia* (799), whereas last year the order was *Columbia, California, Cornell, Michigan, Harvard, Chicago, Pennsylvania, Wisconsin, Illinois, Minnesota, New York, Ohio State, Northwestern, Syracuse, Yale, Nebraska, Missouri, Texas, Kansas, Indiana, Tulane, Iowa, Stanford, Princeton, Western Reserve, Johns Hopkins, Virginia.* If the summer session enrollment be omitted, the universities in the table rank in size as follows: *Columbia* (6,153), *Michigan* (4,923), *Harvard* (4,828), *California* (4,741), *Cornell* (4,605), *Pennsylvania* (4,290), *New York University* (4,063), *Wisconsin* (3,957), *Illinois* (3,948), *Northwestern* (3,619), *Minnesota* (3,418), *Syracuse* (3,392), *Chicago* (3,366), *Ohio State* (3,274), *Yale* (3,265), *Nebraska* (2,483), *Missouri* (2,388), *Indiana* (2,340), *Texas* (2,253), *Kansas* (2,112), *Pittsburgh* (1,833), *Iowa* (1,766), *Stanford* (1,661), *Princeton* (1,568), *Western Reserve* (1,378), *Tulane* (1,238), *Washington University* (958), *Virginia* (799), *Johns Hopkins* (772), whereas last year the order was *Columbia, Cornell, Michigan, Harvard, Pennsylvania, Illinois, Minnesota, California, Wisconsin, New York, Northwestern, Yale, Syracuse, Ohio State, Chicago, Nebraska, Missouri, Kansas, Tulane, Iowa, Stanford, Princeton, Indiana, Western Reserve, Tulane, Virginia, Johns Hopkins.*

Owing to the fact that no statistics were given last year for the individual faculties, it is impossible to compare the gains or losses, as was done for 1910 and previous years, but attention will be called to important changes in connection with the discussion of the individual institutions. So far as the individual faculties of the various universities are concerned, *Harvard* with 2,306 men and 483 women (Radcliffe College) leads in the number of college undergraduates, being followed by *Indiana*, with 1,415 men and 925 women; *California*, with 914 men and 1,425 women; *Michigan*, with 1,550 men and 732 women; *Chicago*, with 879 men and 720 women; *Nebraska* with 645 men and 897 women; *Minnesota*, with 633 men and 908 women; *Wisconsin*, with 749 men and 727 women; *Columbia*, with 819 men and 590 women; *Princeton*, with 1,409 men, and *Texas*, with 773 men and 634 women.

In agriculture *Cornell* leads with 1,185 students, being followed by *Wisconsin* with 802, *Illinois* with 732, and *Ohio State* with 720. In architecture *Illinois* with 341 is followed by *Pennsylvania* with 215, *Cornell* with 133 and *Columbia* with 129. *Syracuse*, with 175 art students, leads in that field; while *New York University* continues to lead in commerce with 1,598 students, being followed by *Pennsylvania* with 636, *Northwestern* with 450 and *Wisconsin* with 317. The largest dental school is at *Pennsylvania*, where 508 students are enrolled, as compared with 478 at *Northwestern*, 252 at *Michigan* and 239 at *Minnesota*. *Northwestern* has the largest divinity school, enrolling 222 students, as against 132 at *Chicago*, 100 at *Yale* and 48 at *Harvard;* these are the only universities in the list that maintain schools of theology.

Syracuse has 177 students of forestry, *Ohio State* 74, *Nebraska* 64 and *Yale* 40; at *California, Harvard, Illinois, Michigan* and *Minnesota* the forestry students are counted in with other departments. *Columbia* has a long lead in the number of non-professional graduate students, there being no less than 1,399 students enrolled in its faculties of political science, philosophy and pure science. *Columbia* is followed by *Harvard* with 532 students, *Chicago* with 490, *Yale* with 429 and *Pennsylvania* with 403. *Wisconsin* has the largest school of journalism, enrolling 95 students as compared with *Columbia's* 72, *Indiana's* 70 and *Missouri's* 55. The largest law school is at *Harvard University*, where 740 students are registered in this subject; *New York University* follows with 693 students, *Michigan* with 654 and *Columbia* with 457. In medicine *New York University* leads with 408, being followed by *Johns Hopkins* with 351, *Tulane* with 349, *Columbia* with 336 and *Pennsylvania* with 313. *Syracuse* has the largest number of music students, namely, 855, there being 452 at *Northwestern* and 118 at *Indiana* and at *Kansas*. The Teachers College of *Columbia University* is by far the largest school of education connected with any of the institutions in the list. It has an enrollment this fall of no less than 1,606 students, as against 540 students of education at *Indiana*, 478 at *Pittsburgh*, 398 at *Texas* and 355 at *New York University*. *Columbia* also has by far the largest school of pharmacy, enrolling 420 students, as against 195 at *Pittsburgh*, 193 at *Northwestern* and 176 at *Illinois*. As for the scientific schools, *Cornell* continues to maintain its lead in this branch, enrolling 1,419 students, as against *Michigan's* 1,284, *Yale's* 1,139, *Illinois's* 965, *California's* 735, *Wisconsin's* 728, *Ohio State's* 726, *Pennsylvania's* 713 and *Columbia's* 634. In veterinary medicine *Ohio State* leads with 155, being followed by *Cornell* with 120 and *Pennsylvania* with 115. All of the above figures for individual faculties are exclusive of the summer session attendance. The largest summer session in 1912 was at *Columbia University*, where 3,602 students were enrolled, as against 3,531 at *Chicago*, 2,275 at *California*, 1,741 at *Wisconsin*, 1,324 at *Michigan*, 1,307 at *Cornell*, 1,197 at *Indiana*, 1,116 at *Tulane* and 1,046 at *Harvard*.

The largest number of officers is found at *Columbia*, where the staff of teaching and administrative officers consists of 867 members, as against 825 at *Cornell*, 771 at *Harvard*, 595 at *Wisconsin*, 577 at *Illinois*, and 549 at *Pennsylvania*.

California.—The 894 students listed under extension and similar courses were divided as follows: San Francisco Institute of Art, 225; Wilmerding School of Industrial Arts, 190; University Farm School, 150; Short Course in Agriculture, 187; Correspondence Courses in Agriculture, 142. In addition there is an enrollment of approximately 37,000 students in the farmers' institutes, etc. Of the 159 law students, 62 are graduate students in the department of jurisprudence, candidates for the degree of J.D., and 97 are registered in the Hastings College of Law as candidates for the degree of LL.B. Of the medical students, 82 are enrolled in the first and second years at Berkeley, and 19 in the third and fourth years at San Francisco, and 17 in the third and fourth years at Los Angeles.

Columbia.—97 college students are also registered in the professional faculties of the university (in the exercise of a professional option) as follows: 45 seniors in law, 26 seniors and juniors in medicine, 9 seniors in mines, engineering and chemistry, 5

seniors and juniors in fine arts, 6 seniors and juniors in journalism, and 6 seniors in Teachers College. Of the students in education, 1,379 were enrolled in Teachers College and 227 in the school of practical arts.

Cornell.—No information was given as to the number of summer session students who returned for work in the fall, and an estimate was therefore made based on the returns in the previous year.

Harvard.—The 483 students mentioned under "College, Women" are registered at Radcliffe College, where 80 of the 532 graduate students are also to be found.

Illinois.—The decrease in the total registration this year is caused by the discontinuation of the work in medicine and dentistry on June 30, 1912. The 269 students listed under "other courses" consist of 33 students in the library school, and 236 women enrolled in the courses in household science. The latter students are registered in three colleges, namely, arts, science and agriculture, but are not included in separate figures for these schools.

Indiana.—The large increase is due to the establishment of courses in journalism, music and pedagogy, which were not represented in the table of 1910.

Iowa.—Of the 113 students in medicine, 14 are taking work in homeopathic medicine. The students listed under "extension and similar courses" are students in pharmacy, medicine, the nurses' training school of the college of medicine, and that of the college of homeopathic medicine, in which schools high school graduation is not required for admission. The falling off in the grand total is due to the fact that these students were included in the upper part of the table in previous years. Music is now a part of the new college of fine arts, for the regular courses in which high school graduation is required, but since music students are not required to submit any entrance credentials, it is difficult to tell how many of the fine arts students have met secondary requirements for a collegiate course.

Minnesota.—The decrease in numbers in the college of science, literature and the arts is undoubtedly due to the qualitative requirement for admission. The apparent decrease in law is explained by the change in classification. Under the new administration, the evening law school has been abolished, and that work is now offered through the extension division. The decrease in students electing art is due to the shifting of that department from the college of science, literature and the arts to the college of education. The registration of the graduate school will doubtless equal last year's figure before the close of the present year. The falling off in pedagogy is the result of a change in classification; a number, heretofore registered as specials in that college, are now regular students in the college of science, literature and the arts.

Missouri.—The decrease in the enrollment in the schools of law, journalism and engineering is due to the fact that the standards of admission of these schools have been increased by the requirement of two years of college work in addition to a four-years' high school course. This requirement was first imposed in the session of 1911–12, but in that session the second and third classes in the school of law, and the sophomore, junior and senior classes in the schools of engineering and journalism consisted of students who had entered under the old standards of admission. The elimination of one of these classes explains the decrease in enrollment in these schools during the past session. The decrease will probably be manifested during the next session in the school of law and during the next two sessions in the schools of engineering and journalism. The schools of education and medicine also require two years of

college work for admission, but as this standard was established at an earlier date, all of the students who entered under the lower requirements have been eliminated and the enrollment in these schools is now beginning to increase.

New York University.—The school of commerce shows an increase of 226 over the total enrollment for last year. The requirements in this school are the same as they were last year and the increased attendance shows the demand for such courses. The medical college shows a decrease of 179 from the total enrollment of last year. The loss falls almost entirely upon the freshman class, which numbers 53 this year, as against 206 for November, 1911. The reason for this decrease in the entering class is that beginning with this year, one year of college work has been required for admission in addition to high school graduation. A one year preparatory course covering physics, chemistry, biology and scientific German is being offered for men who expect to enter the medical college next year, and there are at present 52 in this class whose names are included in the total for the collegiate division. The law school shows a small falling off of 16 from last year, which is doubtless due to the fact that in the autumn of 1911 the law school was placed on a strictly three-year basis for the degree.

Northwestern.—There is an increase in every school of the university excepting the medical school, but the most gratifying increase is in the college of liberal arts. A committee of alumni and officers started a campaign last year to interest the graduates in increasing the number of men. The campaign resulted in an increase in men in the freshman class over the previous class of fifty-two per cent.

Ohio State.—The total enrollment, including the summer session, shows but a slight increase, which is due to the fact that the summer school of 1912 showed a decrease of 166 in its enrollment. This was largely due to the fact that the appropriation for the summer school was cut by the legislature from ten thousand to five thousand dollars, and it was necessary that certain courses be eliminated. All secondary work was dropped, and all students were of college or graduate rank and were required to meet the entrance requirements of the college in which they wished to enroll.

Pennsylvania.—While the total enrollment has fallen off as compared with the figures of the preceding year, there is an increase of 82 in the number of first year men. The increase of 4 in the first-year enrollment of the medical school indicates that the heavy falling off in registration due to the gradual raising of entrance requirements since 1908 has been checked, and a healthy reaction should be noticed from now on. The apparent falling off in total enrollment in the veterinary medical school is partly explained by the fact that the graduating class last June, 58, was unusually large. The normal senior class is about forty. The decrease in enrollment in civil, mechanical and electrical engineering is not peculiar to the university this year, as it is reported that there has been a falling off in those courses generally throughout the country.

Princeton.—Of the 1,409 undergraduates, 150 are students in the undergraduate civil engineering department, while the 11 additional students listed under scientific courses are enrolled in the electrical engineering school.

Texas.—In the fall of 1908 the minimum number of entrance units on which a student might be admitted was increased from eight units to eleven units, and the following year from eleven units to twelve units, at which number it has continued until the

present time. Beginning with the fall of 1909, five college courses were required for admission to the department of law, and since the fall of 1910, five courses have been required for admission to the department of medicine. The percentage of men over women registered in the college of arts this session is larger than ever before. This is doubtless explained by the fact that more men than heretofore are taking their pre-medical and pre-law training.

Tulane.—Fourteen of the students listed under medicine are enrolled in the post-graduate medical school. The 10 students listed under "other courses" are taking work in household economy. Inasmuch as no allowance was made in the table furnished for the summer session students who returned for work in the fall, an estimate was made based on the previous year.

Virginia.—1,285 of the students were in attendance on the summer school of 1912, which is not a part of the university session.

Washington University.—The 78 students listed under "other courses" are enrolled in the school of social economy. In addition to the students accounted for in the table, there are 140 registered in the school of fine arts, but these have been omitted because the school does not require a four-year high school course for admission. They have been included, however, under "extension and similar courses." Many of these students have a high school training and a number have even more. In two departments the university has steadily advanced the requirements, and the changes in these departments have lowered the registration and of course affected the attendance materially. In the law school the changes began in 1901–02. In this year a full four-year high school requirement for admission was enforced. In 1904–1905 the course was extended to a full three-year course, and the tuition was raised from eighty to one hundred dollars. In 1909–10 the department was removed from a location well down in the city to the new campus, and in 1910–11 a full year of college work was required for admission in addition to a four-year high school course. As a result of these changes, the registration has decreased from 124 in 1900–01 to 76 on November 1, 1912. The entering classes are showing a recovery from the increased requirement, and the total registration this year of entering students was 29 regulars and 9 unclassified, as against 17 regulars and 8 unclassified when the last change in the requirement of a full year of college work went into effect. More marked still has been the change in the medical school. Here a complete reorganization has been effected, vastly adding to the facilities and to the teaching staff, placing the instructors on a full time basis even in the clinical departments for the burden of the teaching and research, but retaining a considerable number of men on part time to supplement the work of the regular staff in instruction and in the clinics. In 1910–1911 the requirement for admission was advanced to a full year of college work in addition to a four-year high school course, the college requirement involving specific prescriptions in chemistry, biology, physics, German and English. The number received under this new requirement dropped to 13 from 50 the preceding year. Furthermore, the requirements for advanced standing were increased and rigidly enforced. The following year the entering class showed a recovery, the number rising to 23; but in 1912–13 (the current session), the requirement of two years of college work in addition to a full four-year high school requirement for admission, went into effect. This college requirement included specific prescriptions of two years of chemistry, one of biology, one of physics, two of German,

one of English, and electives, and the requirements for admission to advanced standing were further advanced. Again, the tuition fee was raised to one hundred and fifty dollars from a fee ranging from one hundred to one hundred and forty dollars. This increased tuition fee affected all entering students either for the first year class or for advanced standing. Under this new requirement the registration for the entering class dropped to 5 and the number received to advanced standing dropped to 8, although 69 applied for advanced standing and a very great number for admission to the first-year class. As a result of the changes in the medical school, the registration dropped in three years from 185 to 68, and the number will probably decrease next year, as the last of the larger entering classes on the old basis will pass out. The registration of the college, where the admission requirements have remained the same, shows a fair increase.

Western Reserve.—In 1911–12 the law school became, as the medical school has been for some years past, a graduate school.

Wisconsin.—Of the 802 students in agriculture, 50 are graduate students, and of the 728 in the engineering school, 20 are graduate students. The figures for pharmacy are inclusive of 26 students enrolled in the two-year pharmacy course, which does not require four years of high school preparation. The 5 students listed under "other courses" are enrolled in the Wisconsin library school, and are also counted in letters and science. In addition there are 31 students enrolled in the library course, which does not require four years of high school preparation. The figures are also inclusive of the students enrolled in the short courses in agriculture and in dairying. Last year there were 424 in the former and 133 in the latter.

Yale.—The decrease in the enrollment in the law and medical departments is due to the continued application of the recently increased requirements for admittance to these departments. The present general requirement for admission to the Yale law school is a bachelor's degree from a college of approved standing. The general requirement for admission to the medical school is a college degree or evidence of completion of at least two years of regular college work. The registration in the first year classes of the law school and medical school is greater than the final registration in the first-year classes of these schools for last year.

RUDOLF TOMBO, JR.

THE FUR SEAL CENSUS

EVER since the fur seal herd of the Pribilof Islands came into the possession of the United States, through the purchase of Alaska, in 1867, one of the most important practical problems in connection with its management has been the making of some sort of enumeration or estimate of its numbers. The first attempt was made in 1869 by Captain Charles Bryant, first agent in charge of the herd. He estimated that the animals occupied 18 miles of shoreline to an average depth of 15 rods, 20 seals to the square rod, giving a total of 3,265,000 breeding seals and young. He did not estimate the number of non-breeding seals, animals of three years or under of both sexes.

A second attempt was made in 1872–74 by Mr. Henry W. Elliott, a special agent of the Treasury Department. He followed the same method of gross estimate, refining somewhat upon Captain Bryant's work, as it were, reducing to feet and inches what his predecessor had expressed roughly in miles and rods. His breeding area differed radically from that of Captain Bryant—6,386,000 square feet instead of 23,500,000. He, however, assigned only 2 square feet to each individual animal, whereas Captain Bryant gave 14 square feet. These over- and underestimates practically balance each other and leave

the results about the same. Mr. Elliot found a total of 3,193,000 breeding seals and young, 72,000 less than Captain Bryant. He estimated the non-breeding seals also, finding a number sufficient to bring the grand total for the herd up to 4,700,000 animals of all classes.

In 1890 Mr. Elliott duplicated his census of 1872–74. It was a greatly reduced herd he found at that date. The breeding area he estimated at 1,900,000 square feet, and applying to this the same space unit, found 950,000 breeding seals and young.

The next serious attempt to estimate the herd was made in 1895 by Mr. Frederick W. True, of the Smithsonian Institution, and Mr. Charles H. Townsend, then connected with the United States Bureau of Fisheries. The herd had suffered still further decline through the ravages of pelagic sealing, an indiscriminate form of hunting in the open sea particularly destructive to the breeding females. Messrs. True and Townsend were able to count the individual animals on certain breeding areas, 7,479 in all. From charts of the rookeries, on which the areas had been traced at the height of the season, the extent of the counted area was obtained and hence an individual unit of space. Each animal was found to occupy a space of 46 square feet on scattered breeding grounds and half this space on massed grounds. Completing the measure of breeding space for all the rookeries, from the charts, and applying to it the units of space, a total of 131,833 breeding seals and young was found, with non-breeding seals enough to bring the total for all classes up to 155,977.

Coincident with the above estimate was one made by Colonel Joseph Murray, a government agent on the islands. He estimated and counted the breeding families, 5,000, and assigned arbitrarily an average of 40 cows to each, thus reaching a total of 405,000 breeding seals and young.

In 1896 a new investigation of the fur seal herd was begun by a commission under the leadership of President Jordan, of Stanford University. Both the above estimates were before this commission. The method of obtaining the unit of space used by Messrs. True and Townsend commended itself as worthy of imitation, but on test the rookery charts were found unreliable and a new basis of estimate was sought. The areas on which individual cows had been counted in 1895 were recounted, and enough additional space to bring the total up to 16,679 individual cows, in 1,245 families, an average of 13 cows to a harem. A complete count of harems was then made with the intention of applying the average to it after the manner of Colonel Murray.

While this census of 1896 was in progress, however, it was discovered that there were more pups on the counted areas than the number of cows previously counted warranted, and a full count of pups showed them to outnumber the cows two to one. In all previous estimates it had been assumed that at the period of development in rookery population known as the height of the season all or practically all the cows were present. The count of pups proved this to be an erroneous assumption, that in fact when most of the cows were present half at least of them were at sea feeding. The average harem obtained from the count of cows was therefore abandoned and one obtained from the count of pups substituted. This gave a total of 157,405 cows, with a like number of pups, in 4,932 harems, or a total of 319,742 breeding seals and young. The estimate for non-breeding seals in 1896 brought the total for all classes up to 450,000 animals.

In 1909 the writer duplicated this census of 1896, finding 50,626 cows in 1,387 harems, or, adding a like number of pups, a total of 102,639 breeding seals and young, with non-breeding seals sufficient to bring the total for the herd up to 158,520 animals.

The method of enumeration thus established in 1896 has been continued each season since with slight variation. The method of estimate was not held to be exact. It was recognized that exact results could only be obtained by a full count of pups and this was considered in 1896 to be physically impossible. The chief importance of the enumeration,

however, lay in its value as a measure of decline, and for this purpose the results were as satisfactory as a complete count would have been.

By the treaty of July 7, 1911, the United States secured, through the cooperation of Great Britain, Russia and Japan, the abolition of pelagic sealing. The herd was thus freed from the drain upon its breeding stock and hope for its restoration was revived. The season of 1912 was the first under the new treaty. It became important therefore to know the exact status of the herd and a full count of the pups was undertaken and successfully accomplished by the writer. The rookeries of St. Paul Island gave 70,035; those of St. George Island, 11,949—a total of 81,984 pups. As each pup accounts for a mother seal, there was a like number of breeding cows. The harems numbered 1,358, an average of 60 cows to each, giving a total of 165,325 breeding seals and young, with non-breeding seals estimated at 50,412, or 215,738 animals of all classes.

Omitting the non-breeding seals, which can only be estimated, and dealing only with the breeding seals, we find an excess of 62,685 animals over the estimate of 1909. Approximately 15,000 cows reached the rookeries in 1912 and brought forth their young, which under pelagic sealing would have been killed at sea. These with a like number of pups swelled the herd and account for 30,000 of the excess. The remaining 32,685, made up of cows and pups, are accounted for by underestimates in 1909, from applying to large rookeries averages obtained from smaller rookeries. The average harem for all the rookeries in 1912 is 60 cows; that used in making the census of 1909 was 36. If we deduct the 15,000 cows saved through cessation of pelagic sealing, the average harem for 1912 drops to 48. Applying the difference between this and 36 as a correction to the census of 1909 would add to it 16,644 cows and an equal number of pups, 33,288 in all, a figure sufficiently near to 32,685 to show that it is fairly accurate. As a matter of fact the herd has not changed much since 1909. The pelagic catch has merely taken, in the past three seasons, a number equal to the annual increment of gain, that is, the excess of young breeding cows over the natural loss in adults due to old age. By this normal increment of gain, which is about ten per cent. yearly, now protected from loss, will the herd rise to its former populous condition.

The counting of the fur seal herd is a simple but at the same time laborious process. The animals occupy six to eight miles of shore front, in a belt, varying in width with the character of the ground, but never more than 150 to 200 feet, often much less. The work must be done in the first week or ten days of August, between the close of the breeding season and the time when the pups become accustomed to the water. The adult animals are driven off by native helpers. The person counting and his assistant cut off a pod or group of pups, numbering 50 to 100, at a rookery end, forcing it along the beach for a distance of one or two hundred feet. The animals string out in a line, the older and stronger forging ahead, and the counting is done by twos and in groups of threes and fours while they are scattered. It is like counting sheep as they pass through a gate. A second pod is cut off and treated in the same way, and so throughout the length of the rookery. In the end the entire rookery population has merely been shifted along the beach a short distance, the adult animals return and conditions are soon readjusted. At certain places close search must be made for animals asleep or hiding in the crevices of the rocks. Through failure to get all of these at times the counts are slightly under the exact facts. Count must also be made of the dead, of which a number—1,060 for all the rookeries—were found, such deaths being incident to exigencies of rookery life. The counting of the 82,000 pups occupied eight days, the largest single day's work being 20,000.

The process sounds simpler than it really is. The adult animals are always more or less dangerous. The pups themselves have anything but gentle dispositions and their teeth are sharp enough to penetrate rubber boots.

The ground also presents difficulties. Long stretches of unstable bowlders are interspersed with jagged lava potholes. There are cinder slopes and basaltic benches. In places the rocks are worn smooth as glass by the friction of innumerable seal bodies and the bowlders near the water line are always treacherous with slime and slippery sea growths. Over all is the unspeakable Bering Sea weather—without sunshine and alternating between thick and thin fog accompanied by rain, flying spray and howling wind.

The result, however, repaid the effort. For the first time the breeding stock of the herd has been brought within the range of exact figures. The herd is shown to be in better condition than was expected. Its recuperation will be more rapid. The splendid body of pups disproves absolutely the contention which has recently played so important a part in discussions of the herd's condition, namely, that the stock of breeding males has been reduced too low or become invirile and impotent through the operations of land killing. The immediate response of the herd to its release from the drain of pelagic sealing as certainly proves this to have been its sole cause of decline.

GEORGE ARCHIBALD CLARK
U. S. BUREAU OF FISHERIES,
ST. PAUL ISLAND, ALASKA,
August 31, 1912

THE FUR SEAL MORTALITY OF THE PRIBILOF ROOKERIES IN THE ABSENCE OF PELAGIC SEALING [1]

THE breeding season of 1912 for the Pribilof fur seal was the first in many years unaffected by pelagic sealing. The herd has promptly responded to the removal of this determining check to its increase. The deaths on the rookeries reflected not only the arrest of pelagic sealing but the drop in the rate of natural mortality which has been much more rapid than the rate of decrease of the herd. The question of mortality was investigated in 1896 and 1897 by the Fur Seal Commission, and during the past season by the writer, the death of the young being the chief concern in both cases. The loss during the entire season, until the migration of the cows and pups late in the fall, has never been covered, but the major portion occurs earlier and indicates the proportions of the mortality from natural causes. In 1896 and 1897, putting aside the heavy loss from pelagic sealing by using only the data prior to August 15, the approximate date on which starvation caused by the pelagic catch began to be fatal to the young on the rookeries, the two chief causes of mortality of pups were uncinariasis (hookworm disease) and natural starvation, the former leading and placing a heavy incubus on the herd. The seal mother bears a single pup each year, and will nurse no other than her own offspring. Pelagic sealing therefore caused the starvation of the young by an artificial interference with the herd, while natural starvation is due to accidental deaths of females which have nursing pups and probably also to their failure to find their offspring after returning from trips to sea. It was estimated at 30.8 per thousand in 1896. The total loss from all causes in 1896 before the middle of August was about 90 per thousand.

The data obtained in 1912 make necessary some readjustment. The total natural loss to August 22 on St. Paul Island is 880, or 12.5 per thousand. From starvation to the middle of August a death rate of 4.3 per thousand is indicated, and from uncinariasis for the whole season a rate of much below 1 per thousand. Uncinariasis has thus become a minor and insignificant cause of loss, ranking not nigher than fourth, a result which must be due solely to the thinning out of the herd, for no artificial measures against *Uncinaria* have been applied. The worm could not be found on Polovina, Gorbatch and the Northeast Point rookeries, all formerly well infested. The old rookery strongholds for this disease in the sands of Zapadni, Reef and especially Tolstoi, are alone now occupied and they yielded only 17 uncinariated pups, 5 of which were associated with starvation, out of a total of 175 examined. By making these sandy

[1] Published by permission of the Commissioner of Fisheries.

areas rocky uncinariasis can probably be made and kept negligible.

Not so vulnerable are the rest of the natural losses and most of them are beyond the reach of any preventives man can apply. Starvation is perhaps still the most serious of these, but at least a close second are the constant and typical cases of asphyxia neonatorum, or suffocation of the new born, a hitherto unidentified fatality among the seals. This is an early loss, begins with the first births and of course ceases promptly with the last. Eighteen per cent. of the dead pups examined before the middle of August were thus asphyxiated, but as the autopsies did not begin (save for two cases) until July 23, when the height of the season was well passed, the indicated death rate of 2.3 per thousand is much too low. Pups dead of asphyxia neonatorum are promptly recognized by the presence of meconium and complete pulmonary atelectasis, or lungs without air. The meconium is made up of the products of metabolism of the fetus, accumulated in the large intestines during gestation, and is voided soon after birth. A few cases have only partial meconium and incomplete atelectasis. The immediate cause of the failure to establish breathing is inferred to be obstruction by the fetal membranes. Most pups are born more or less invested by parts of what was the bag of waters. The cow delivering her pup instantly proceeds to tear off the caul with her teeth, but she does not always succeed until after the pup is dead. The dead pups seldom show adhering membranes but one striking example, found on St. George Island by Mr. Clark, is significant. The caul was intact, fitted perfectly the whole head and effectually sealed the respiratory passages. Usually the little victims never get their first breath. Trampling or overlying at the critical moment probably prevents breathing in a few cases independently of the fetal membranes. There is no evidence that any of the pups examined was dead before birth.

In 1896 and 1897 this species of suffocation must have ranked third, or possibly second, in importance. Many of the earlier dead of those years, which were seen lying largely inaccessible in the heart of the harems and inferred to belong with the losses from *Uncinaria,* were probably suffocated at birth. It is characteristic of this loss that many of the dead are found in the original area of the harem as first formed, and all of them directly on breeding grounds. The pups die on the spot where born. Deaths from this cause will continue indefinitely, the defect in seal obstetrics being remediable by nature alone. But the loss may perhaps not increase much faster than *pari passu* with the growth of the herd, which is not the case with uncinariasis and apparently not with starvation and other losses. Roughly speaking there are now one third to one half as many breeding seals and young as in 1896; but the pup loss is one seventh and the adult loss one fifth that of 1896. As the various well-known losses have decreased in a much faster progression than the decrease of the herd, they may be expected to increase with its growth with corresponding rapidity, though the matter is to some extent influenced by such controllable factors as the proportion of bulls to cows.

The death of adult breeders is mainly from fighting, accidents of pregnancy and of other kinds. During the season of 1912 this loss was about 30 as against 159 in 1896.

An incidental discovery of less importance but of much interest, was made by Mr. Clark and the writer during the counting of the pups. It has been supposed that the ability to swim is not a birthright of the fur seal pup but an acquirement gained by diligent practise in August. The stampeding into the sea and ready swimming early in August of hundreds of pups which had never before been in the water, and corroborative observations, show that the pup can swim just as soon as it acquires sufficient strength and can manage its limbs.

M. C. Marsh

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St. Paul Island, Alaska

MEMORIAL OF A CENTENARY

The interest of the annual meeting of the Academy of Natural Sciences of Philadelphia was enhanced by the presentation of an advance copy of the fifteenth volume of the

quarto *Journal* of the society published in commemoration of the celebration last March of the one hundredth anniversary of its foundation. The volume consists of 753 pages illustrated by 59 plates, six of which are in colors. The work has been printed on specially prepared paper and is a noble specimen of typography. It is divided into two sections, the first consisting of the proceedings of the centenary meeting, an account of the banquet, a list of delegates, and a selection from the letters of praise and congratulation received from corresponding institutions at home and abroad, while the second part contains the following memoirs contributed by members and correspondents:

"Human Spermatogenesis, Spermatocytes and Spermiogenesis: A Study of Inheritance," by Thomas Harrison Montgomery, Jr.

"A Contribution to the Paleontology of Trinidad," by Carlotta J. Maury, with plates drawn by Gilbert Dennison Harris.

"Early Adaptation in Feeding Habits of the Starfishes," by John M. Clarke.

"Mimicry in Boreal American Lepidoptera," by Henry Skinner.

"The Petrographic Province of Neponset Valley, Massachusetts," by Florence Bascom.

"Description of a New Fossil Porpoise of the Genus *Delphinodon* from the Miocene Formation of Maryland," by Frederick W. True.

"A Synopsis of the Fishes of the Genus *Mastacembelus*," by George A. Boulenger.

"The Faunal Divisions of Eastern North America in Relation to Vegetation," by Spencer Trotter.

"The Relation of Smell, Taste and the Common Chemical Sense in Vertebrates," by George Howard Parker.

"On the Supposed Tertiary Antarctic Continent," by Sir William Turner Thistelton Dyer.

"Mollusk Fauna of Northwest America," by William Nealy Dall.

"The Relation of Plant Protoplasm to its Environment," by John Muirhead Macfarlane.

"Tetraplasy, the Law of the Four Inseparable Factors of Evolution," by Henry Fairfield Osborn.

"The Phylogenetic Value of Color Characters in Birds," by Witmer Stone.

"Further Experiments with Mutations in Eyecolor of *Drosophila:* the Loss of the Orange Factor," by Thomas Hunt Morgan.

"On the Radiation of Energy," by James Edmund Ives.

"The History and Zoological Position of the Albino Rat," by Henry Herbert Donaldson.

"The Gorgonians of the Brazilian Coast," by Addison E. Verrill.

"New Observations in Chemistry and Mineralogy," by George Augustus Koenig.

"A Study of the Variations and Zoogeography of *Lignus* in Florida," by Henry Augustus Pilsbry.

"Analyse der Süd-Amerikanischen Heliceen," by H. von Ihering.

"Experimental Studies in Nuclear and Cell Division in the Eggs of *Crepidula*," by Edwin G. Conklin.

A view of the academy's building serves as a frontispiece to the volume.

A copy of the academy's first publication in 1817, an unpretentious small octavo, was placed beside the sumptuous volume just issued. The earlier issue was printed on paper which has held its own through the wear and tear of more than four-score years and ten, although by no means specially manufactured for the purpose. A distinction was given to the volume by contributions from Ord, Say, Nuttall, Waterhouse, Maclure and Lesueur and by the really beautiful engravings of the last named naturalist, but the contrast of this first publication with the volume just completed is not so great as that of the academy of 1817, housed in three little rooms up Gilliam's Court with the society as now established and endowed.

The chairman of the library committee, Dr. Thomas H. Fenton, spoke at the last meeting of the academy of the commemorative volume as a fine specimen of book making and of the value of its contents as contributions to science, calling special attention to its promptness of issue, as distinguished from the delay usual in the appearance of such memorial publications. He offered the following which was unanimously adopted:

Resolved, That it is the sense of this meeting that the sincere thanks of the academy are due to the recording secretary, Dr. Edward J. Nolan, for his untiring zeal and industry in the preparation and editing of the splendid memorial volume pre-

sented to-night and for its extraordinarily prompt completion.

The entire edition will be ready for distribution before the end of the year.

SCIENTIFIC NOTES AND NEWS

A BRONZE bust of Dr. Eugene W. Hilgard, emeritus professor in the University of California, was recently unveiled in the foyer of the new agricultural hall at the same time that the building was dedicated. The occasion was also marked by the formal investiture of Professor Thomas F. Hunt as dean of the department of agriculture.

ON Friday, the thirteenth of December, a complimentary dinner was given at the Cosmos Club to Dr. Theodore Nicholas Gill, of the Smithsonian Institution, in commemoration of the seventy-fifth year of his life and of the fifty-fifth year of his publishing activities as a naturalist. More than one hundred guests were in attendance, mainly scientific men. Admiral Stockton, U.S.N., president of the George Washington University, presided. Dr. L. O. Howard, permanent secretary of the American Association for the Advancement of Science, acted as toastmaster. The speakers were Dr. Herbert Putnam, librarian of Congress; Dr. C. E. Monroe, professor of chemistry in George Washington University; Dr. B. W. Evermann, of the U. S. Bureau of Fisheries; Dr. A. F. A. King; Dr. Hugh M. Smith, of the Bureau of Fisheries, and Dr. W. J. Holland, of the Pittsburgh Museum. Dr. Gill's remarks in reply were largely retrospective of his long residence in Washington and his connection with the Smithsonian Institution. Many letters were read from prominent naturalists and old friends of Dr. Gill. The dining room was festooned with fish-nets; aquaria were placed here and there upon the tables, and corals and sea forms of different kinds were intermingled with flowers as table decorations.

ON the evening of December 13 a dinner was given in honor of Dean W. F. M. Goss by local members of the American Society of Mechanical Engineers, members of the faculty of the College of Engineering and members of the Council of Administration of the University of Illinois. The dinner was given in recognition of the election of Dean Goss to the presidency of the American Society of Mechanical Engineers.

CAPTAIN ROALD AMUNDSEN will be the guest of honor at the annual banquet of the National Geographic Society on January 11, in Washington. Rear Admiral Robert E. Peary will act as toastmaster. Captain Amundsen, a gold medalist of the National Geographic Society, for his voyage through the Northwest passage, is again gold medalist of the society for the discovery of the South Pole.

AMONG the prizes offered for competition by the Académie des Sciences the most important is the Bréant prize (100,000 francs, $20,000) for the cure of Asiatic cholera. From the income of the Bréant foundation the Paris Academy of Sciences has awarded prizes of $500 to Dr. Carlos J. Finlay and to Dr. A. Agramonte, of Havana for their work on the rôle of the mosquito in the propagation of yellow fever.

OXFORD UNIVERSITY has conferred the degree of doctor of science on Professor Ernest William Hobson, fellow of Christ's College, and Sadlerian professor of pure mathematics at Cambridge.

THE Royal Geological Society of Cornwall has awarded its Bolitho gold medal to Mr. Geo. Barrow, for his services to Cornish geology.

MAJOR E. H. HILLS, F.R.S., has been appointed honorary director of the observatory, University of Durham.

DR. ADELINE AMES, Ph.D. (Cornell, '12), has been appointed assistant forest pathologist in the Bureau of Plant Industry, Washington, D. C.

DR. JAMES A. HONEIJ, Cambridge, has been appointed assistant physician at the Leper Colony, Penikese Island. He will have the use of the laboratory of the Harvard Medical School and will make a study of the fifteen cases of leprosy now on the island.

PROFESSOR GEORGE GRANT MACCURDY, of Yale University, has been elected a corresponding member of the Société des Américanistes de Paris.

PROFESSOR JOHN W. HARSHBERGER, of the University of Pennsylvania, has been elected president of the Philadelphia Natural History Society, which meets at the Wagner Free Institute of Science. He has been made a member of the council of the Pennsylvania Forestry Association from Philadelphia County.

MR. FRANK M. CHAPMAN, of the American Museum of Natural History, and Mr. Louis Agassiz Fuertes, of Ithaca, will leave New York in January to explore the Columbian Andes. They will make a survey of Colombia, beginning at the Magdalena River and working eastward to the Bogota plateau, then on up to the high mountains, reaching an altitude of 14,000 feet, and down into the Orinoco basin. The work will take about three months. Its purpose is primarily to obtain material for other "habitat groups" for the museum. Mr. Fuertes will sketch the birds, the flora and the landscape features of the country.

DR. GEORGE E. HALE lectured at the Massachusetts Institute of Technology on December 17 on "The Magnetic Field of the Sun."

DR. J. M. COULTER, of the University of Chicago, gave an address on "Problems in Plant Breeding," before the honorary fraternity, Delta Theta Sigma, at Ames, Iowa, on December 13. Professor N. E. Hansen, of Brookings, South Dakota, gave an address for the same society on "Siberia," on December 7, with special reference to the work of plant introduction work in the United States.

Two lectures on different phases of "Efficiency Engineering" have recently been delivered before the faculty and students of the College of Engineering of the University of Illinois. One lecture was by Mr. Harrington Emerson, of New York City; it emphasized the need of scientific study and adaptation of the human element in the industries. The second lecture was by Dean C. H. Benjamin, of the School of Engineering of Purdue University; it laid special stress on the necessary limitations of any efficiency system.

"THE Rural Problem" was the subject of an address delivered before the students of the University of Wisconsin College of Agriculture last week by Dr. F. B. Mumford, dean of the University of Missouri College of Agriculture. This was the first of a series of similar lectures to be given during the winter.

BY invitation of the University of Calcutta, Dr. A. R. Forsyth, F.R.S., will give a course of advanced lectures in pure mathematics early next year. His subject is "The Theory of Functions of Two or More Complex Variables."

THE Dutch sculptor, Pier Pander (Rome), has executed a bronze medallion of van't Hoff. *Nature* states that any one desiring to purchase a copy of it should send a postcard to Professor Ernst Cohen, van't Hoff Laboratorium, University, Utrecht, Holland. The medallion will then be sent by the firm entrusted with the work. If 100 copies are sold the price will be 6.50 Marks. The price will be reduced to 5.50 Marks if 200 copies can be sold. The medallion has been executed after a portrait relief in marble by Pier Pander.

DR. WILLIAM JAMES VAUGHN, who has held the chair of mathematics since 1882 and the chair of astronomy since 1895 at Vanderbilt University, died on December 17, aged seventy-eight years.

MR. SAMUEL ARTHUR SAUNDER, who while engaged as a schoolmaster, carried on important researches in astronomy, especially concerning the surface of the moon, died on December 8, aged about sixty years.

MR. PETER CAMERON, author of a work in four volumes, which appeared between the years 1882 and 1893, on "British Phytophagous Hymenoptera," died on December 1.

THERE will be no meeting of Section C (Chemistry), at the Cleveland meeting of the American Association for the Advancement of Science. The short time intervening between the decision of the American Chemical Society not to meet in affiliation with Section C this winter and the date of the meeting has made it impossible to prepare a suitable program. The meeting of Section C will, therefore, be postponed until the following year.

UNIVERSITY AND EDUCATIONAL NEWS

The University of Wisconsin plans to develop in due time a full course in medicine in accordance with the highest standards, and in so doing it will utilize the clinical facilities of Milwaukee as far as they are available according to the decision of the regents at their last meeting. At present only two years of the four-year medical course are given.

In connection with the announcement of the removal of Professor Herbert J. Webber from Cornell University to the University of California, the position which he will fill was incorrectly given. He will be director of the Citrus Experiment Station and dean of the Graduate School of Tropical Agriculture. The University of California has for several years maintained four separate substations in southern California. These are to be united into an enlarged research station which will probably be located at Riverside. While this station will be designated the Citrus Experiment Station after the dominant industry of southern California, the work will be with all crops which are grown in that region. The coupling with the station for agricultural research of the Graduate School of Tropical Agriculture will make it unique among our agricultural experiment stations.

At the State University of Kentucky Dr. Joseph H. Kastle has been appointed director of the Agricultural Experiment Station and dean of the College of Agriculture.

Dr. Jesse More Greenman has resigned from the University of Chicago and the Field Museum of Natural History to accept an associate professorship in botany at Washington University and the position of curator of the herbarium at the Missouri Botanical Garden. He will assume his duties in St. Louis on January 1.

Mr. C. R. Orton, of Purdue University, has been elected to fill the vacancy at the Pennsylvania State College, made by the resignation of Professor H. R. Fulton. Mr. Orton will take up his duties on January 1, and will have charge of the teaching and investigation in plant pathology which includes forest pathology as well as the other special courses in plant diseases.

DISCUSSION AND CORRESPONDENCE

PHILIPPINE SHARKS

To the Editor of Science: In the issue of Science for July 19, 1912, Mr. C. Tate Regan makes observations on some new Philippine sharks described by me and Mr. Lewis Radcliffe in two papers in *Proceedings of the U. S. National Museum* (Vol. 41, 1912). (1) Mr. Regan expresses the opinion that a shark characterized by a single dorsal fin, taken by the *Albatross* in the Sea of Mindanao at a depth of 585 fathoms and by us made the type of a new family and genus, is not what it seems to be; he "suspects" that the absence of the first dorsal is abnormal or accidental. This suspicion is not justified by any evidence afforded by the specimen itself, which has been critically examined by Dr. Theodore Gill and other competent zoologists, who were consulted in advance of publication. (2) Mr. Regan finds that *Nasiqualus,* established as a new genus of Squalidæ, "corresponds to a section of *Centrophorus* which has already received the names *Acanthidium* and *Deania.*" *Nasiqualus* certainly falls within the composite genus *Centrophorus* as conceived by Mr. Regan, but in either dentition or dermal structure it differs markedly from *Deania* and *Acanthidium.* The last named genus is not made a synonym of *Centrophorus* by Mr. Regan in his paper cited (*Annals and Magazine of Natural History,* Vol. II., eighth series, 1908) but of *Spinax* Cuvier, a name antedated by seven years by Rafinesque's *Etmopterus.* (3) Mr. Regan concedes that "a second new genus, *Squalidus,* is valid." Two esteemed correspondents, apparently having seen Mr. Regan's communication, have recently notified me that *Squalidus* is not a tenable name, being preoccupied. This name, however, does not appear anywhere in our paper. The name used was *Squaliolus,* in allusion to the small size of the type species, the fully mature male being only 15 cm. long.

H. M. Smith

Bureau of Fisheries,
Washington, D. C.

BERARDIUS BAIRDII IN JAPAN

During 1910 while in Japan studying and collecting whales for the American Museum

of Natural History, I saw in the Imperial Museum at Tokyo the skeleton of a Ziphiioid whale belonging to the genus *Berardius*. Upon inquiry it was learned that the skeleton had been secured from a whaling company which conducted operations on the shores of Tokyo Bay.

As it was then too late in the season to permit of a personal visit to the whaling grounds, my friend Mr. M. Matsuzaki, of the Toyo Hogei Kabushiki Kaisha (Oriental Whaling Co., Ltd.) offered to secure a specimen for the museum. He was able to do so and in 1911 a very complete skeleton reached New York.

This specimen is referable without doubt to *Berardius bairdii* Stejneger, the type locality of which is Bering Island, Bering Sea.

According to Dr. F. W. True,[1] the collection of the National Museum contains three skulls and three skeletons of this rare species, all of which are from Alaska with the exception of one taken at Centerville, California. I do not know that this whale has been recorded in other localities; thus the skeleton in the Tokyo Museum with the one just received in New York extends to Japan the range of both the genus and species.

So far as I have been able to learn the "Tsuchi-kujira," as the Japanese call *Berardius bairdii*, is taken in summer and only in Tokyo Bay, not appearing at other points upon the coast. The other species of this interesting genus, *B. arnouxi* Duvernoy, has been recorded only in the seas about New Zealand.

ROY C. ANDREWS
AMERICAN MUSEUM OF NATURAL HISTORY

ON CITING THE TYPES OF NEW GENERA

AT the Boston Zoological Congress the following recommendation was adopted:

To facilitate reference, it is recommended that when an older species is taken as the type of a new genus, its name should be actually combined with the new generic name, in addition to citing it with the old generic name.[1]

The point is, that a bibliographer should be able to cite the necessary new binomial for the typical species, from the place where the genus was originally defined. I have never heard any objection to the course suggested, but, presumably through inadvertence, the recommendation is not always followed. A noteworthy instance has just come to hand in Mr. Edmund Heller's interesting paper on new genera of African ungulates.[2] He does indeed print the combination *Dolichohippus grevyi*, but *Sigmoceros lichtensteini* (Peters), *Beatragus hunteri* (Sclater), *Oreodocas fulvorufulus* (Afzelius), *Ammelaphus imperbis* (Blyth) and *Nyala angasi* (Angas), types of their respective genera, are nowhere given their supposedly correct names.

T. D. A. COCKERELL

IN THE INTERESTS OF BETTER SPEAKING

TO THE EDITOR OF SCIENCE: Would it be at all worth while, now that the innumerable scientific papers of the midwinter are about to be read, to urge their readers to take a few elementary lessons in elocution before they ascend their platforms? It is difficult to compute to what extent esthetic pleasure, as well as facility of comprehension, would be added to if men of science understood better the art of putting their communications before the public. The main work of the professional elocutionist would be to show the prospective reader how to produce full, clear, rotund chest tones, instead of the thin, clouded, head tones which they too often adopt. If the dozen or so of precious hours that this would take is too much to demand, perhaps the following simple rules might be of some assistance; I am sorry that they are so very elementary, but in point of fact they are rules which are violated by fully one half of those who read:

1. Stand erect, with chest expanded and not contracted.

2. Consult a physician and see that the nasal bones do not obstruct the nasal passages.

[1] "An account of the Beaked Whales of the Family Zyphiidæ in the Collection of the U. S. National Museum," Bull. 73, 1910, pp. 60, 61.

[1] SCIENCE, October 18, 1907, p. 521.

[2] Smithsonian Misc. Coll., November 2, 1912, Vol. 60, No. 8.

3. If manuscript is to be read from, hold it in the hand (and hold it high); manuscript which is stationary on a desk causes a rigidity of the body which should be avoided.

4. The length of line of the type-written manuscript must be short—not more than seven inches. This is very important. The long line of the ordinary typed manuscript is convenient for the type-writer, but it is fatal to the reader. The effort necessary to catch the right line as the eye returns to the left-hand margin of the paper consumes energy which should be devoted to securing that mysterious *rapport* that must be established between reader and hearer if the function is not to be a painful one. For the same reason the type must be good and black, and the lines far apart. Whatever contributes to the physical ease of the speaker conduces also to that free and undistracted state of mind which is indispensable to the securing of the desired *rapport*.

5. Better still—make a mental note of the *Art und Weise* of those men of science (half our number perhaps) who, whether by instinct or by early training, know how to address an audience effectively. There is a subtle mental attitude about them, quite aside from physical details, which can perhaps be better caught by instinctive imitation than by conscious intention. May their tribe increase!

6. If, in addition, every individual reader would, in his own interest, see to it that there is enough oxygen in the audience-room to permit of ready comprehension on the part of his hearers, then indeed would the mid-winter scientific meeting become such a joy to the spirit as would brighten, in retrospect, many a coming month of solitary hard labor.

The essential matter of inspiring papers is always at hand; a little furbishing up of method of presentation is all that is needed to make that matter far more effective, in the way of presentation, than it is, too often, at present. Of this the reader may be certain—if he insists upon beginning his paper with his voice thin, low and veiled, and directed downwards upon the floor instead of outwards towards the level of his hearers' ears, the spirits of his auditors, so far as they have any esthetic quality at all, will also descend to their boots, and will remain there until another speaker gives them a chance at better nourishment.

X. Y. Z.

SCIENTIFIC BOOKS

Principles of Microbiology. By V. A. Moore. Ithaca, N. Y., Carpenter & Co. Cloth. Pp. xl + 506, 101 illustrations. $3.50.

It is unfortunate that the limited field which this book covers was not indicated in the main title. For as the subtitle tells us it is a "treatise on bacteria, fungi and protozoa pathogenic for domesticated animals." Even then it does not claim to be complete, but, as the author says, is a "text-book for veterinary students beginning the study of microbiology. It is not exhaustive but rather elementary in character."

The first 188 pages and the last 65 are given over entirely to the discussion of general bacteriological matters along the same lines that we find in any of the half dozen books on general bacteriology. As we look through the list of chapters we find the same familiar titles as in all the others: Historical Sketch, Bacteria and their Place in Nature, Morphology of Bacteria, Classification, Bacteriological Apparatus, Sterilization and Disinfection, Preparation of Culture Media, Isolation and Cultivation of Bacteria, Microscopic Examination, Vital Activities of Bacteria, Relation of Bacteria to Disease, Use of Animals, Bacteriology of Water and Milk, Immunity, Serum Diagnosis and Vaccine Therapy. The remaining 253 pages, or just half the book, treat of the application of these general principles to veterinary matters.

Although we recognize the fact that the book is intended only for beginners and does not pretend to be complete yet we feel that the half of the book dealing with general bacteriology might with advantage have been left out altogether. For this general part while admittedly incomplete does not in many instances give as good, nor as accurate and up to date discussion of the topics mentioned as

do some of the general text-books. Neither is this part specific enough in its directions to serve the student as a laboratory guide. It would have been better to have referred the beginner to the standard text-books for the general discussion, or to have provided him with specific directions for undertaking laboratory work leading up to the applications of veterinary bacteriology. This would have allowed the author more space for the extension and elaboration of the more valuable and specific part of the book in a way which he is well qualified to undertake.

It is hardly necessary to specify the shortcomings of the general part more than to point out that the historical sketch contains no reference to the other and earlier workers than Leeuwenhoek; the chapter dealing with classification is inadequate and confusing, and includes practically none of the recent work; in describing the preparation of culture media the methods are old-fashioned and but scant notice is given to the present-day standard methods; under the description of cultures the standard card of the Society of American Bacteriologists is not mentioned, although it is included in the chapter on classification, where it does not belong.

The chapter dealing with the bacteriology of water and milk is entirely unsatisfactory. The Standard Methods of Water Analysis now in use in practically all laboratories in this country are neglected altogether, although they are mentioned as giving methods for the preparation of culture media. The methods of interpreting the results of an analysis are not at all clear nor do they accurately represent present-day practise.

The discussion of the relation of bacteria to milk, a subject which touches closely veterinary matters, is also given but brief consideration. Too great stress is laid on such matters as the bactericidal property of milk, a subject about which there is much question, and the topic of bacteria in milk, particularly the pathogenic bacteria, is treated altogether too briefly. The author might very well have expanded this discussion to considerable length in a book of this character.

The good points of the book, and they are many, are mainly to be found in the part dealing particularly with veterinary matters. Here we have a careful summary of our knowledge of veterinary microbiology. But even here clearness and accuracy seem many times to have been sacrificed to brevity, although on the whole this part of the book is deserving of much praise. In the treatment of many topics we might mention important points which have been omitted, as for instance, Winslow's classification of the *Streptococci*, the occurrence of *M. gonorrhœa* in animals, the recent separation of *Bacillus coli* into its varieties, the modern methods of staining *Treponema*. But while sins of omission are frequent, those of commission are relatively rare and unimportant. The illustrations are not abundant but are well chosen, though their quality is not up to the standard set by the rest of the typography.

F. P. GORHAM

BROWN UNIVERSITY

Biology: An Introductory Study. By H. W. CONN. Boston, Silver, Burdett & Co. 1912. Price $1.50.

THE opinion of the reviewer was once solicited by a representative of one of the large publishing houses of this country as to who could write a good elementary biology and the answer was given that Professor Conn could do this. I do not believe that the publication of his present book had any reference to my statement, but it has warranted this statement. The book presents the subject in the most satisfactory manner of any of the texts which have appeared. In the first place it is a dignified college biology, demanding the serious attention of the student. The treatment is logical, beginning with the simple and working towards the complex and decidedly at variance with the views of those who believe it pedagogical heresy to put a compound microscope in the hands of the beginner. The illustrations are inelaborate, but quite ample and very well selected. At the ends of the chapters are references to books and papers, mainly of historical interest and a group of

suggestions is likewise given for laboratory work, but in no sense detailed laboratory directions; they concern hints for handling material which is not everywhere used for study. One of the most important things about the book is the etymological explanations of the meaning of technical terms, to be found throughout the text, while at the back is a well-selected glossary-index in one. There are some minor errors here and there, as the spelling of Robert Hooke's name as Robert Hooker, amyolitic for amylolytic, but these are few. The reviewer parts company with the author in regard to the prominence of amitosis in the light of the work of recent research in hydroid, cestode, pathologic and other departments; I do not believe that it is sufficiently emphasized that nutrition is the same in photosynthetic forms as in holozoic organisms, but that the difference is in the *obtaining* of nourishment, the one from inorganic substances, the other from foods ready formed. In the chapter "The Relations of the Chromatin to Heredity," the author thinks that it is "almost incredible that there can be in such a small compass the traits of characters which an individual transmits to its offspring." I think likewise and I do not believe that such is the case, but that the chromatin is a *determiner* of these traits, in the sense of Johanssen; unless this matter is presented to the beginning student in clear epigenetic terms, the whole matter will automatically reduce itself to a *reductio ad absurdum* in his mind.

The book is a strong argument for the biological Monroe Doctrine—biology for the biology classes. The discovery that animals and plants are built upon the same general plan and are in reality different aspects of the same thing is nearing a century in age, yet we teach the subject as if plants and animals were entirely disparate, and that there are no phenomena in common. The introductory course in physics and in chemistry aims to be general and to treat the science as a whole. It is as logical for the chemist to introduce his beginning students to organic chemistry, as for the biologist to make his elementary course mere botany or zoology. It is as futile to argue that no man can teach biology because he can not be a good botanist and a good zoologist at the same time as to assert that the teacher of physical chemistry can not be successful because he can not be both physicist and chemist: the point is that he is neither, he is a physical chemist, as the biologist should be a biologist. Professor Conn has given ammunition to the advocates of courses in general biology for beginning students.

M. M.

Handbook of Mental Examination Methods. By SHEPHERD IVORY FRANZ, Ph.D. New York, 1912. Nervous and Mental Disease Monograph Series No. 10.

Dr. Franz's volume adds another to the several recent handbooks of psychological methods and, as from a psychiatric angle, an addition quite worth making. It is an account of the simpler experimental methods to be used in the study of mental affections. The ground covered is the usual field of psychological experimentation, with a few special chapters, as one on Speech and Aphasia. The experimental methods described are taken somewhat from the literature, but are also largely the author's own, and in some of these latter instances it appears as though the field should have been more thoroughly gone over with reference to the work of others along similar lines. As to the single experiments described, the critic will appreciate that some experience with them is necessary to estimate their value for clinical purposes. Under Sensation are described the simple procedures with which most of us are familiar, though the methods of pain-measurement seem to be regarded as more objective than is the case. The reflexes and automatic acts are nearly passed over in the chapter on movement, though Franz has himself contributed to our knowledge of their pathology. Only the simpler methods are described for the observation of motor speed, accuracy, etc. The chapter on aphasia does not deal with experimental methods, but aims at sound guidance to clin-

ical analysis. Much experimental material follows under the titles of attention, apprehension and perception, while the need for the special understanding of the immediate meaning of these words is recognized and met. Clinical methods have had a relatively large share in the development of experiment along these lines. As in other cases, the chapter on memory leaves the reader with a decided *sentimental d'incomplétude,* but the clinician should find very convenient the samples of material for the different sorts of memory tests. The work of Kent and Rosanoff has due recognition in the chapter on association, though not the work of the Zurich school, which is the opposite of the usual case. Some simple material which can be used for calculation tests is also presented. Under the "Time of Mental Processes" are discussed various forms of sorting tests, also of the *A*-test, these latter apparently all of Franz's own devising, though several other forms are extant. The remaining chapters are of an observational rather than experimental bearing, but are very useful in their present relation, especially the scheme of general examination, which is an excellent groundwork. In closing, there are described the elementary statistical procedures which the clinical observer might have occasion to use.

It is evident that to adequately write a book of this sort one must have the clinical viewpoint continually in mind and keep it continually in the reader's mind; the author has accomplished this better than other writers of similar books who have been physicians. The commentaries, both general and on the special tests presented, should be an exceedingly useful complement to the meager training in psychology which the younger physicians in our mental hospitals have usually received; it is for their hands that the book seems intended, and for whom it should perform its most useful work. The reference lists, however, are ill-proportioned and too condensed. The book is clear and very practical within certain limits, but it is not as good a book as its author should have written.

F. L. W.

Building Stones and Clay-Products: A Handbook for Architects. By HEINRICH RIES. New York, John Wiley & Sons; London, Chapman and Hall, Limited.

THE work under the above title, comprising upwards of 400 pages, is acknowledgedly an attempt to prepare an elementary treatise on the subjects mentioned for the benefit of the students in the College of Architecture of Cornell University and for architects in general.

The first 250 pages of the work are devoted to building stones, the remainder to clay and clay-products. In attempting to cover so much ground within a limited number of pages much has to be omitted, and the question naturally arises if the subject does not suffer by such condensation to the extent of largely losing its value. The portion devoted to stone contains nothing that is not to be found in other easily available works and its usefulness must depend largely upon the method of arrangement of the subject material. The second portion is little more than an abbreviation of what the author has already included in his well-known work on "Clays, Their Occurrence, Properties and Uses." The subject is one on which the writer is acknowledgedly an authority.

The numerous illustrations are for the most part well selected and executed. A very good bibliography, glossary and index accompany the work.

A few minor errors are observed, as in the credit to Merrill on page 49, and to Watson on page 50. These are, however, comparatively immaterial matters.

GEO. P. MERRILL

SPECIAL ARTICLES

THE RELATIONSHIPS OF THE CHESTNUT BLIGHT FUNGUS

THE writer was the first to question the identity of the chestnut blight fungus, *Diaporthe parasitica* Murrill. In the 1908 Report of the Connecticut Agricultural Experiment Station he said:

We are not yet sure that *Diaporthe parasitica* has not been collected before under some other

name. Professor Farlow calls our attention to the fact that "it comes more naturally under the genus *Endothia*, and is closely related to *E. gyrosa*." In de Thümen's "Myc. Uni.," No. 769, is a specimen under this name on *Castanea vesca* collected by Saccardo in Italy in 1876, whose Cytospora stage (the only stage showing in our specimen) seems quite like that of our chestnut fungus.

Ever since writing the above the writer has been endeavoring to gain additional evidence along this line. Since so-called *Endothia gyrosa* had been reported by Ellis and others on *Quercus* in this country, we made a special search on that host in Connecticut for this and similar fungi. It was not, however, until a field trip was made to Rock Creek Park, Washington, D. C., during the American Association for the Advancement of Science meeting of 1912, that we ran across the object of our search. Here we found, besides *Diaporthe parasitica* in its asco-stage on chestnut, a very similar fungus, also in the asco-stage, on two species of oak. A careful microscopic examination of the fungus on the oaks showed that it differed slightly from that on the chestnuts through its slightly narrower ascospores.

Shortly after making these collections we received from Saccardo specimens of *Endothia gyrosa* in their asco-stage on both chestnut and oak from Italy, and a careful microscopic examination of these showed that they were not only identical with each other, but also with those collected on oaks at Washington. This led me to say in a paper read shortly after at the conference called by the Pennsylvania Chestnut Blight Commission:

> The writer has since made a careful hunt for *Endothia gyrosa*, and has specimens of it on two species of oak collected in [Connecticut? and] the District of Columbia. Cultures have been made from these and from *Diaporthe parasitica* on chestnut obtained from the same localities. Our studies of these cultures and specimens from various localities are not yet complete, but they have gone far enough to say definitely that *Diaporthe parasitica* belongs in the same genus with the *Endothia gyrosa* on oak, and is at least very closely related to it, though at present my opinion is that they are distinct species.

And further on we said:

> Now, if *Endothia gyrosa* has a variety of hosts, including chestnuts, in Europe, and prefers a southern habitat, what of its preferences in this country? . . . *Endothia gyrosa* has been found on as many hosts in this country as in Europe, and likewise chiefly from the south. Why may we not expect to find it there on the chestnut?

In fact, we were then on our way south with this purpose in view, and we succeeded in finding at all the places which we visited *Endothia gyrosa* on both chestnut and oak that in its asco-stage or otherwise could not be distinguished microscopically from the fungus on the oaks at Washington and on the oak and chestnut sent by Saccardo from Italy. This led us to add, as a footnote to our Harrisburg paper, the following statement:

> After the Harrisburg conference, the writer went south especially to see if *Endothia gyrosa* or *Diaporthe parasitica* occurred there on chestnut, as suggested in this paper, though never having been so reported. Stops were made at Roanoke and Blacksburg, Va., Bristol, Va. and Tenn., at Ashville and Tryon, N. C., and at Lynchburg, Va., and at each place the suspected fungus was found on both chestnut and oak, and more frequently on the former. This fungus occurred as a languishing parasite or as a saprophyte, usually at the base or on the roots of the trees, and was never found forming isolated cankers on the otherwise sound sprouts, as is *Diaporthe parasitica* in the north. Apparently this fungus is the same on both the oak and chestnut, and the same thing as the so-called *Endothia gyrosa* on the same hosts in Europe. What its exact relationship is to *Diaporthe parasitica* has not yet been fully determined. In gross appearance its fruiting pustules are scarcely different, except possibly slightly less luxuriant as a rule. Its pycnidial spores, Cytospora stage, are apparently identical with those of *D. parasitica*, but the ascospores are evidently as a whole less luxuriant; that is, they are somewhat smaller, and especially slightly narrower. Whether these differences are those of a strain, variety, or distinct species, is yet to be determined by cultures, inoculations and further study.

At the request of the writer, Professor Farlow also wrote a paper (which was read by the writer) for the Chestnut Blight Conference, presenting his studies as to the identity of the chestnut-blight fungus. Farlow had a

linear-spored *Endothia* on oak from America that he decided was related to but distinct from *Diaporthe parasitica,* and the European specimens of *Endothia gyrosa,* which latter, he stated, could not be distinguished morphologically from *D. parasitica.* It is quite evident, therefore, that Farlow was the first to call specific attention to the fact that in America there is a linear-spored *Endothia* on oak that is distinct both from *Diaporthe parasitica* of America and *Endothia gyrosa* of Europe; while the writer first called attention to the fact that there is a narrowly-oval spored form on both chestnut and oak in this country that is apparently distinct from *D. parasitica,* but identical with *Endothia gyrosa* on the same hosts in Europe.

Neither at this meeting, nor previously, had any other American botanist published on his own observations any statement of the relationship of *Diaporthe parasitica* to the genus *Endothia.* Rankin, however, in his paper presented at this conference, did say:

> The speaker has recently collected and examined a fungus indistinguishable from the chestnut canker disease on dead chestnut bark in several places in Virginia,

thus showing that he (and also Spaulding, as was learned later by discussion with him) had collected *Endothia gyrosa* without recognizing it. Some time before the Pennsylvania conference, however, von Höhnel, of Austria, and Saccardo, of Italy (in a letter to the writer), had compared specimens of *Diaporthe parasitica* from America with *Endothia gyrosa* from Europe, and, like Farlow, had come to the conclusion that morphologically they were identical. They knew nothing about the linear-spored *Endothia* and the real *Endothia gyrosa* in America.

Shortly after the conference a paper by Shear appeared in the April number of *Phytopathology,* in which he says:

> Our early unpublished studies of the chestnut bark fungus, made in 1907, convinced us that it was most closely related to the genus *Endothia,* as that genus is at present interpreted by mycologists. This opinion was also reached by Dr. Farlow, as reported by Clinton in 1908.

He also remarks further on:

> It is still uncertain whether *Diaporthe parasitica* is an indigenous American fungus or not. It is also a question whether the fungus reported as *Endothia gyrosa* and *E. radicalis* in Europe is the same as that to which the same names are at present applied in this country, and the exact relation of this European fungus to *Diaporthe parasitica* is also somewhat doubtful. The writer is investigating these questions and hopes to discuss them more fully later. One point at least we believe to be definitely determined, and that is the specific distinction between *Diaporthe parasitica* Murrill and *Endothia radicalis* (Schw.).

This last point had already been pointed out by Farlow in his paper, since he and Shear both had reference to the linear-spored form of *Endothia,* as shown by specimens since received by the writer from both.

In SCIENCE (May 10, 1912) Farlow republished his Harrisburg conference paper with some additions. In this paper Farlow speaks for the first time of the specimens collected by the writer. He says:

> As far as one can distinguish species by their morphological, apart from their pathogenic, characters, *Diaporthe parasitica* seems to me to resemble the Italian *Endothia radicalis* so closely that they can not be separated specifically unless it be by some peculiarity not hitherto recorded. There is still another point which should be considered. Is the fungus of our chestnut blight ever found on other trees? I have received a series of interesting specimens collected by Professor G. P. Clinton, which will illustrate this point. In some the bark of chestnuts and in others the bark of oaks is infested with an *Endothia* which in general appearance and in microscopic structure seem to me to be the same species.

Farlow further states that these specimens are distinct from the linear-spored form on oak.

Yet, in spite of all these statements, there have recently appeared in the October number of *Phytopathology* a second article by Shear and another by P. J. and H. W. Anderson—two papers which ignore, probably unintentionally, the published statements of Farlow and the writer, thereby giving their readers

the impression that they are presenting certain facts for the first time. In his article Shear comes to the conclusion, after a trip to Europe, during which he collected specimens of *Endothia gyrosa* (*Endothia radicalis* of European authors, as he calls it) on chestnut, that this "is identical, morphologically, with *Diaporthe parasitica* Murrill, as found in America." This same conclusion, as we have shown, was previously made by von Höhnel, Farlow and Saccardo, but nevertheless is not quite correct, since our studies show that the ascospores of *Endothia gyrosa* from both Europe and America and on both oak and chestnut, are as a rule narrowly oval, while those of the true chestnut blight are broadly oval. However, since both forms have intergrading spores, the difference is very easily overlooked. Shear also apparently did not know that the real *Endothia gyrosa* of Europe also occurs as a native species in America, since he further states:

> As a result of our studies to date, we are of the opinion that *Diaporthe parasitica* Murrill is the same as *Endothia radicalis* of European authors, but not of Schweinitz, and that it was probably introduced into this country from Europe and has gradually spread from the original point of introduction, its spread being facilitated chiefly by borers or other animal agencies which produce wounds favorable for infection by the fungus.

The Andersons in their paper come to the conclusion that there are three species of *Endothia* in the United States, as follows:

> (1) *E. radicalis* (Schw.) Fr., (2) the true blight fungus—why not call it *Endothia parasitica?*—and (3) the Connellsville fungus, for which we propose the name *E. virginiana*, and for which we expect to write a description as soon as more of the European specimens have been examined.

It is too bad that they did not first carefully examine these European specimens, since their new species is the same thing as *Endothia gyrosa*. However, like the writer, they distinguished the difference between the ascospores of their so-called new species and those of the true chestnut blight. Also their culture and inoculation work agree in the main with the unpublished results of the writer. With their interpretation of Schweinitz's original description of *Sphæria gyrosa* as belonging to an entirely different fungus (a species of *Nectria*) we can not agree, as we believe Schweinitz originally had our fungus when he wrote his description in "Syn. Fung. Car.," No. 24.

The writer has received specimens from Farlow of his linear-spored *Endothia*, from Shear of this same fungus, which he calls "*Endothia radicalis* (Schw.)," and also of his recent collections of "*Endothia radicalis* of European authors" on chestnut from Italy, and from Detwiler of the Connellsville fungus (*E. virginiana* Anders.). We have had a chance to compare all of these under the microscope and most of them in cultures with the specimens we have collected and with the European specimens previously mentioned as received from Saccardo. We have also examined the Ellis and other specimens under *Endothia gyrosa* in the herbarium of the New York Botanical Garden and the Schweinitz specimens of *Sphæria gyrosa* and *S. radicalis* in the Philadelphia Academy of Science. We have made cultural experiments with *Diaporthe parasitica* extending over four years, and with *Endothia gyrosa* for nearly a year. We have made numerous inoculation tests with these two forms during the past summer. We also have cultures of the linear-spored *Endothia*. From this work and a careful review of all the literature bearing even remotely on the subject, we are positive that there are three forms of *Endothia* in America, all of which we believe to be native, and that at least one of them also occurs in Europe. We shall briefly discuss these as (1) the linear, (2) the narrowly-oval and (3) the broadly-oval spored forms of *Endothia*, as follows:

1. *The Linear-spored Endothia, E. radicalis* (Schw.) Farl.—The specimen from Florida issued by Ellis in "N. A. Fungi" No. 1956 as *Endothia gyrosa* (Schw.) is apparently this species, though the specimen in our set shows only a few ascospores and no asci. Likewise, the specimens issued by Ravenel as *Sphæria gyrosa* Schw. in his "Fungi Car" No. 49, on *Liquidambar* and *Quercus*, belong here, as

shown by the ascospores present in certain of the specimens the writer has examined. Ellis, in his description, "N. A. Pyren.," p. 552, however, really describes the next species better than this, since his measurements of the ascospores fit that species very closely. Ellis apparently merely copied Winter's measurements of the ascospores of *Endothia gyrosa* of Europe. His references to American specimens apparently all relate to the linear-spored form, and Anderson, who made Ellis's drawings, gives a fairly good illustration of this (a little too broad), probably made from the exsiccati specimen cited above.

Shear and Anderson refer this linear-spored species to *Sphæria radicalis* of Schweinitz, and we are inclined, after careful study of both the Schweinitz and the Fries descriptions, to believe that they may have had reference to this particular fungus. None of the original specimens, however, show ascospores, as far as known. Farlow, and not Fries, was the first to consider this form as coming under *Endothia,* and the first to definitely mention that the ascospores were linear, so we give him as the second authority for the name. Schweinitz also described the Cytospora stage of this same fungus, on wood of *Liquidambar* from Salem, as a new species, *Peziza cinnabarina,* No. 840 of his "N. A. Fungi," as shown by microscopic examination of this material. This would to-day come under Saccardo's genus *Endothiella* of the imperfect fungi.

The ascospores of the specimens we have studied vary from linear to linear-oblong, are occasionally slightly curved, are provided with an indistinct septum which probably is often absent, and are chiefly 6–10 μ (rarely 12 μ) long by 1–2 μ wide. The fruiting pustules of this species in its Cytospora stage are very similar to or identical with those of the other two forms. This species, however, is sharply differentiated through its ascospores from the other two, and to our mind represents the primitive species from which the next developed.

Perhaps most of the specimens called *Endothia gyrosa* in American herbaria come under this species, though it is impossible to say so definitely, since most of them are represented only by the Cytospora stage. So far as we have seen ascospore specimens, these have come from the south, so that they give it a present known distribution from Mississippi and Florida up to North Carolina. It is not known from Europe, apparently, but the assumption is not unreasonable that it might be found there, especially in the extreme southern part.

2. *The Narrowly-oval Spored Endothia, E. gyrosa* (Schw.) Fr.—The ascospores of this species vary from elliptical-oblong to narrowly oval, often tapering at one or both ends, have an evident septum, and are chiefly 6–9 μ long by 2–3.5 μ wide. Numerous comparative measurements of those taken from both oak and chestnut in Europe and America show no difference. When we compare the spores with those of the preceding species, however, the difference is quite evident to any one; when compared with those of the following form, the difference, while much less marked, is still sufficient for one with experience to distinguish the two by the slightly narrower spores of the species under consideration.

We believe that this is the fungus described by Schweinitz and by Fries as *Sphæria gyrosa,* and later made the basis of the genus *Endothia* by Fries. There is no doubt but that it is the European fungus called indifferently *Endothia gyrosa* or *E. radicalis,* which in its varied career has been placed under such other genera as *Valsa, Melogramma* and *Diatrype.* Streinz gives *Sphæria fluens* Sow. as a synonym, and Shear, after an examination of the specimen in the Kew Herbarium, thinks it the same, so far as can be told from the Cytospora stage. Other old-time names have been listed by botanists as synonyms, though probably not always correctly. Saccardo, having the Cytospora stage on wood instead of bark, created a new genus, *Endothiella,* with *E. gyrosa* as its type species. He knew its relationship to *Endothia gyrosa,* however. We are indebted to Saccardo for specimens of this type, and it is readily recognized as a stage similar to the small, simple, conical Cytospora fruiting pustules of *En-*

dothia gyrosa on wood in the southern part of this country. The true blight fungus also produces this modification on the wood of cut stumps in the north as does *E. radicalis* in the south. So far as the writer has seen, the asco-stage never develops later in these simple Cytospora fruiting pustules of *Endothiella*.

While some American botanists are ready enough to admit the identity of *Endothia gyrosa* of Europe, they question its relationship to *Sphæria gyrosa* of Schweinitz, upon whose specimens from North Carolina the species was originally founded. This doubt is brought about partly by the fact that, as in the case of *Sphæria radicalis* Schw., there are to-day no specimens of *Sphæria gyrosa* collected by Schweinitz that show the asco-stage, and this stage is necessary to properly identify any of these species. The writer thinks he has sufficient reasons, without the ascospores, to identify *Sphæria gyrosa* Schw. as the recognized *Endothia gyrosa* of Europe to-day. These are as follows:

1. While we have not looked for *Endothia gyrosa* at Salem, N. C. (the type locality of *Sphæria gyrosa*), we have no doubt that specimens of it can be found there to-day, since we collected it at points both north and south of that region.

2. Schweinitz gave the hosts as decaying bark of knots, also living bark of *Fagus* and *Juglans*. So far as the writer knows, neither *Endothia gyrosa* in Europe or this or a similar fungus in America has been found on either of these hosts. He has made a careful search on beech, butternut and walnut both north and south, during the past two years, without finding any suspicious fungus that he could connect with Schweinitz's *S. gyrosa*. Farlow has called attention to the question of error on the part of Schweinitz in determining hosts, as follows:

> Too much weight, however, should not be placed on the hosts given by Schweinitz, for an examination of fungi of different kinds collected by him shows that in his statements as to the hosts he was not always to be trusted.

This would be especially true of fungi collected on the exposed roots of trees, a common habitat of this fungus. Even if Schweinitz made no error in the determination of the hosts, we know that certain American botanists, as Marshall, about the time of Schweinitz's publication of his "Syn. Fung. Car." used the generic name *Fagus* to include the chestnut as well as the beech, and perhaps Schweinitz may have used it in this sense!

3. Both Schweinitz and Fries, to whom Schweinitz sent specimens, recognized *Sphæria gyrosa* and *S. radicalis* as distinct species, but with a very similar aspect. Both made descriptions of each of these species, and Fries placed them in separate sections of the genus *Sphæria*. Doubt as to identity would seem to be entirely removed by Fries's later note on *S. gyrosa*, in "Elench. Fung.," p. 84, where he states:

> With new examples sent by Schweinitz, others sent from western France by Guepin, and perhaps also those from Levieux, agree in every way. These tubercles break forth regularly from the bark of *Quercus racemosa*, but on barked wood the same thing is present simple in all respects, crowded, subconfluent, punctiform, without a distinct stroma. . . .

The latter is a very good description of the *Endothiella* stage already referred to.

4. The only specimen of *Sphæria gyrosa* in the mounted Schweinitz collection at the Philadelphia Academy of Science is No. 1431, which is evidently not the type, but a specimen received years after the original description, sent by Torrey from New England. This has already been shown by Farlow, Shear and the Andersons to be something else, a *Nectria*, and its identification as *Sphæria gyrosa* seems to be an error on Schweinitz's part, since he apparently had lost his type specimen when he received this. However, Farlow has a specimen in the Curtis Herbarium at Harvard, of which he writes me:

> The Schweinitzian specimen of *S. gyrosa* in Herb. Curtis at the present time shows no asci or spores, but there is a sketch with the specimen made by Curtis, from which it may be inferred that he saw spores, and that they were like those of *Diaporthe parasitica*.

Taking all the evidence into consideration, we can not see why the *Sphæria gyrosa* of America discussed by Schweinitz does not as certainly relate to the present *Endothia gyrosa* of Europe and America as does the *Sphæria gyrosa* of Europe discussed by Fries, on which no one raises a question. From Schweinitz's description of *S. gyrosa* and *S. radicalis* we believe he either had both of the species now recognized here, or else he had the Cytospora (*Endothiella*) and the mature stages of one, and described these as two species. In the latter case the evidence, as shown by the Curtis drawing, is more in favor of these descriptions applying to the narrowly-oval than to the linear-spored form. We think, however, that the simplest and best solution, until positive proof to the contrary is presented, is to decide that Schweinitz had both species. From their indistinguishable Cytospora stage, which was the stage usually found, it was natural enough that in time European botanists should place *S. radicalis* and *S. gyrosa* together in one species, especially if the former does not occur in Europe.

Having established the identity of our narrowly-oval spored form, what about its appearance in cultures and its action when inoculated into living hosts? Cultures from various localities in the south, from both chestnut and oak, have been under observation for over nine months, and all of these present identical characters that distinguish them rather easily from the true chestnut blight fungus when grown under the same conditions. We give these distinguishing characters briefly under our discussion of the latter fungus.

Inoculation tests were likewise made on seedling and sprout growths of both oak and chestnut, from cultures of *Endothia gyrosa* from both oak and chestnut, and these uniformly gave different results from the true blight fungus when inoculated under similar conditions. In other words, in no case did we succeed in producing very evident cankers from this fungus, and in most cases the inoculations were absolute failures. Yet there were indications of a semi-parasitic nature with a few inoculations made under conditions rather unfavorable to the host. The fungus is evidently largely a saprophyte, but with slight parasitic tendencies.

This fungus has so far been found on chestnut and oak in this country from North Carolina to southern Pennsylvania. It also occurs on these hosts in France, Italy, Switzerland and apparently in several other European countries. Saccardo gives other hosts and a wider distribution, but an examination of asco-material is necessary to verify these.

3. *The Broadly-oval Spored Endothia, E. gyrosa* var. *parasitica* (Murr.).—This is the true chestnut blight of the northeastern United States. Originally described as a new species, *Diaporthe parasitica*, by Murrill, it has since been called *Valsonectria parasitica* by Rehm and *Endothia parasitica* by the Andersons. Other botanists already mentioned do not distinguish it from the *Endothia gyrosa* just discussed. All botanists who have recently made a thorough study of it, however, seem to agree that it belongs more properly under the genus *Endothia*, as first suggested by Farlow and the writer, than under *Diaporthe*. From our own study we can not agree with those who think it identical morphologically with *Endothia gyrosa*, yet we believe it agrees with that species so closely that it belongs under it as a variety rather than ranks as a distinct species, as considered by the Andersons. Hence the name given in the heading.

The ascospores vary from narrowly- to broadly-oval, sometimes tapering somewhat to one or both ends, have a distinct septum at which they are sometimes slightly constricted, and are chiefly 6–10 μ long by 2.75–5 μ wide. Those of *S. gyrosa*, as given above, are 6–9 μ long by 2–3.5 μ wide, thus showing the chief difference to be in their width. Cultures of this fungus as compared with those of *Endothia gyrosa* grown on potato, lima bean and oat agars, give certain constant differences most strikingly shown perhaps when young on the potato and when old on the oat agar. These differences, briefly pointed out, are as follows:

1. The true blight fungus fruits earlier and more abundantly and discharges the spore drops more conspicuously than *Endothia gyrosa*.

2. It has more numerous, but less evident, smaller and more embedded fruiting bodies than the latter, where they are often elevated, distinct pustules, less covered by the exuding spore drops.

3. It develops a much less luxuriant aerial mycelium than the latter, except possibly in potato agar, where the growth in both at first is largely embedded, and much more highly colored with the former.

4. Its aerial mycelium, at first white, in old cultures is finally much less uniformly and highly orange colored than that of the latter, especially on oat agar, where the difference in the luxuriance and color of the two is usually striking.

Inoculations proving the parasitic nature of the chestnut blight fungus have been made previously by Murrill and others. Our inoculations were nearly all with pure cultures from various sources. We have produced cankers on seedling trees and chestnut sprouts, but more readily on the latter. We have produced cankers on chestnuts with cultures obtained originally from oak as well as from chestnut. We have also produced cankers, but much less readily and less conspicuously, on oak sprouts with cultures originally obtained from both oak and chestnut. We have had some differences in results of inoculations, which may be due either to the age of the cultures, season of inoculation, condition of host, original virulence of material used, or to these factors combined. Most of our inoculations with chestnut blight were made with proper checks and with similar inoculations with *Endothia gyrosa*. Our checks have all remained free, and the differences between the true blight inoculations and those of *E. gyrosa* have usually been marked.

The true chestnut blight has been found from New Hampshire to Virginia on several species of chestnut and oak, though rarely on the latter. This variety seems to be the most northern of the forms as indicated by present known distribution. It has not been recognized as yet outside of the United States.

We have gone into this subject minutely because a foreign origin of the chestnut blight fungus is of vital importance to those who advocate its control by cutting down infected trees and destroying their bark. Recently Smith, in October *Outing*, has gone to the extreme in advocacy of this quarantine method of control by outlining a plan for the expenditure of over four and a half million dollars. If, as advocated by the writer, the fungus is a native species, which, because of weather conditions unfavorable to its hosts, thereby weakening their vitality, has suddenly assumed an unusual and widespread prominence, it may in time go back to its previous inconspicuous parasitism. If, on the other hand, it can be proved to be an imported enemy, there is at least some basis for the fight for control, upon the whole impracticable, originally advocated by Metcalf and now so strongly pushed by those in charge of the work in Pennsylvania.

G. P. Clinton

Connecticut Agricultural Experiment Station,
New Haven, Conn.,
November 22, 1912

THE CONVOCATION WEEK MEETING OF SCIENTIFIC SOCIETIES

The American Association for the Advancement of Science and the national scientific societies named below will meet at Cleveland, Ohio, during convocation week, beginning on December 30, 1912.

***American Association for the Advancement of Science*.**—President, Professor Edward C. Pickering, Harvard College Observatory; retiring president, Professor Charles E. Bessey, University of Nebraska; permanent secretary, Dr. L. O. Howard, Smithsonian Institution, Washington, D. C.; general secretary, Professor H. E. Summers, State College, Ames, Ia.; secretary of the council, Professor H. W. Springsteen, Western Reserve University, Cleveland, Ohio.

***Section A—Mathematics and Astronomy*.**—Vice-president, Professor E. B. Van Vleck, University of Wisconsin; secretary, Professor George A. Miller, University of Illinois, Urbana, Ill.

Section B—Physics.—Vice-president, Professor Arthur Gordon Webster, Clark University; secretary, Dr. W. J. Humphreys, Mount Weather, Va.

Section C—Chemistry.—Vice-president, Professor W. Lash Miller, University of Toronto; secretary, Professor C. H. Herty, University of North Carolina, Chapel Hill, N. C.

Section D—Mechanical Science and Engineering.—Vice-president, Dr. J. A. Holmes, U. S. Reclamation Service; secretary, G. W. Bissell, Michigan Agricultural College, East Lansing, Mich.

Section E—Geology and Geography.—Vice-president, Professor James E. Todd, University of Kansas; secretary, Professor George F. Kay, University of Iowa.

Section F—Zoology.—Vice-president, Professor William A. Locy, Northwestern University; secretary, Professor Maurice A. Bigelow, Teachers College, Columbia University, New York City.

Section G—Botany.—Vice-president, Professor D. S. Johnson, The Johns Hopkins University; secretary, Professor Henry C. Cowles, University of Chicago, Chicago, Ill.

Section H—Anthropology and Psychology.—Vice-president, Dr. J. Walter Fewkes, Bureau of American Ethnology; secretary, Professor George Grant MacCurdy, Yale University, New Haven, Conn.

Section I—Social and Economic Science.—Vice-president, John Hays Hammond, New York City; secretary, Seymour C. Loomis, 69 Church St., New Haven, Conn.

Section K—Physiology and Experimental Medicine.—Vice-president, Professor J. J. McCleod, Western Reserve University; secretary, Professor George T. Kemp, 8 West 25th St., Baltimore, Md.

Section L—Education.—Vice-president, Professor J. McKeen Cattell, Columbia University; secretary, Professor C. Riborg Mann, University of Chicago, Chicago, Ill.

The Astronomical and Astrophysical Society of America.—December 30–January 4. President, Professor E. C. Pickering, Harvard College Observatory; secretary, Professor Philip Fox, Dearborn Observatory, Evanston, Ill.

The American Mathematical Society.—December 31–January 2. President, Professor H. B. Fine, Princeton University; secretary, Professor F. N. Cole, 501 West 116th Street, New York City.

The American Federation of Teachers of the Mathematical and the Natural Sciences.—Between December 30–January 4. President, Professor C. R. Mann, University of Chicago; secretary, Eugene Randolph Smith, The Park School, Baltimore, Md.

The American Physical Society.—President, Professor W. F. Magie, Princeton University; secretary, Professor Ernest Merritt, Cornell University, Ithaca, N. Y.

The American Society of Biological Chemists.—December 30–January 1. President, Professor A. B. Macallum, University of Toronto; secretary, Professor A. N. Richards, University of Pennsylvania, Philadelphia, Pa.

The American Physiological Society.—December 30–January 1. President, Dr. S. J. Meltzer, Rockefeller Institute for Medical Research, New York City; secretary, Professor A. J. Carlson, University of Chicago, Chicago, Ill.

The Society for Pharmacology and Experimental Therapeutics.—December 30–31. President, Professor John J. Abel, The Johns Hopkins University; secretary, Dr. John Auer, Rockefeller Institute for Medical Research, New York City.

The American Society of Naturalists.—January 2. President, Professor E. G. Conklin, Princeton University; secretary, Professor A. L. Treadwell, Vassar College, Poughkeepsie, N. Y.

The American Society of Zoologists.—December 30–January 1. *Eastern Branch:* President, Dr. A. G. Meyer, Tortugas, Fla.; secretary, Professor J. H. Gerould, Dartmouth College. *Central Branch* (in charge of meeting): president, Professor H. B. Ward, University of Nebraska; secretary, Professor W. C. Curtis, University of Missouri, Columbia, Mo.

The Association of American Anatomists.—December 31–January 2. President, Professor Ross G. Harrison, Yale University; secretary, Professor G. Carl Huber, 1330 Hill Street, Ann Arbor, Mich.

The Entomological Society of America.—December 31–January 1. President, Professor Stephen A. Forbes, University of Illinois; secretary, Professor Alexander D. MacGillivray, 603 West Michigan Ave., Urbana, Ill.

The American Association of Economic Entomologists.—January 1–3. President, W. D. Hunter, Dallas, Tex.; secretary, A. F. Burgess, Melrose Highlands, Mass.

The American Microscopical Society.—December 31–January 1. President, Dr. F. D. Heald, Philadelphia; secretary, T. W. Galloway, Millikin University, Decatur, Ill.

The Botanical Society of America.—December 31–January 3. President, Professor L. R. Jones, University of Wisconsin; secretary, Dr. George T. Moore, Botanical Garden, St. Louis, Mo.

Botanists of the Central States.—Between December 30 and January 4. President, Professor T. H. Macbride, University of Iowa; secretary, Professor Henry C. Cowles, University of Chicago, Chicago, Ill.

The American Phytopathological Society.—December 31–January 3. President, Dr. G. P. Clinton, New Haven Agricultural Experiment Station; secretary, Dr. C. L. Shear, Department of Agriculture, Washington, D. C.

The American Nature-Study Society.—December 30–31. President, Professor Benjamin M. Davis, Miami University; secretary, Dr. Elliot R. Downing, University of Chicago, Chicago, Ill.

The Association of Official Seed Analysts.—January 2. President, Dr. E. H. Jenkins, New Haven, Conn.; secretary, E. Brown, U. S. Department of Agriculture, Washington, D. C.

The Society for Horticultural Science.—December 31. President, W. T. Macoun, Ottawa, Canada; secretary, C. P. Close, U. S. Department of Agriculture, Washington, D. C.

American Association of Official Horticultural Inspectors.—January 2–3. President, Dr. T. J. Headley, New Brunswick, N. J.; secretary, T. B. Symons, College Park, Md.

The American Anthropological Association.—December 30–January 3. President, Dr. J. Walter Fewkes, Bureau of Ethnology; secretary, Professor George Grant MacCurdy, Yale University, New Haven, Conn.

The American Folk-Lore Society.—January 1. President, John A. Lomax, University of Texas; secretary, Dr. Charles Peabody, Peabody Museum, Cambridge, Mass.

The American Psychological Association.—December 30–January 1. President, Professor Edward L. Thorndike, Columbia University; secretary, W. Van Dyke Bingham, Dartmouth College, Hanover, N. H.

The Sigma Xi Convention.—January 2. President, Professor Henry T. Eddy, University of Minnesota; secretary, Dr. Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

Gamma Alpha Graduate Scientific Fraternity.—December 31. President, Professor William Crocker, University of Chicago; secretary, Professor H. E. Howe, Randolph-Macon College, Ashland, Va.

NEW HAVEN

The Geological Society of America.—December 28–31. President, Professor H. L. Fairchild, Rochester University; secretary, Dr. Edmund Otis Hovey, American Museum of Natural History, New York City.

The Association of American Geographers.—December 27–30. President, Professor Rollin D. Salisbury, University of Chicago; secretary, Professor Albert Perry Brigham, Hamilton, N. Y.

The Paleontological Society.—December 30–31. President, David White, U. S. Geological Survey; secretary, Dr. R. S. Bassler, U. S. National Museum, Washington, D. C.

BOSTON

The American Economic Association.—December 27–31. President, Professor Frank A. Fetter, Princeton University; secretary, Professor T. N. Carver, Harvard University, Cambridge, Mass.

The American Statistical Association.—December 27–30. President, Professor Walter F. Willcox, Cornell University; secretary, Carroll W. Doten, 491 Boylston Street, Boston, Mass.

The American Sociological Society.—December 27–31. President, Professor Albion W. Small, University of Chicago; secretary, Scott E. W. Bedford, University of Chicago, Chicago, Ill.

The American Association for Labor Legislation.—December 27–28. President, Professor Henry R. Seager, Columbia University; secretary, Dr. John B. Andrews, 131 East 23d St., New York City.

The American Home Economics Association.—December 30–31. President, Miss Isabel Bevier, University of Illinois; secretary, Benjamin R. Andrews, Teachers College, Columbia University, New York City.

NEW YORK CITY

The Society of American Bacteriologists.—December 31–January 2. President, Dr. Wm. H. Park, New York City; secretary, Charles E. Marshall, Amherst, Mass.

The American Philosophical Association.—December 26–28. President, Professor Frank Thilly, Cornell University; secretary, Professor Edward G. Spaulding, Princeton University, Princeton, N. J.

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